SCIENCE

New Series.
Vol. VI. No. 145.

FRIDAY, OCTOBER 8, 1897.

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A STATEMENT CONCERNING THE MARINE BIOLOGICAL LABORATORY AT WOOD'S HOLL, MASS.

THE undersigned wish to state to the public, and especially to those who have contributed to the support of the Marine Biological Laboratory, the circumstances which have resulted in their separation from the management of the institution of which they were recently trustees.

1. The Laboratory was founded by the Woman's Education Association, in cooperation with the Boston Society of Natural History at Annisquam in 1881, and in 1888 it was completely reorganized and changed into a corporation under the laws of Massasetts. Its affairs have been managed by a board of trustees, three of whom were members of the Woman's Education Association. All the members of the original board resided in or near Boston. A few years later the board was enlarged to take in representatives of universities in various States. The original board decided upon the location, scope and organization of the laboratory, bought the land at Wood's Holl, designed and erected the first building, selected and purchased the original equipment, and appointed Dr. Whitman director to administer the laboratory. The funds for the establishment of the institution came almost exclusively from Boston. During the following years additional land was bought, and five important additions to the buildings were made, for all of which the funds were secured through the exertions of the Boston trustees, with, however, a few lesser contributions from elsewhere. In 1896 another building was erected at a cost of $3,500, and of this

amount by far the larger part was raised outside of Boston and its connections. The total amount of money contributions is $41,029, of which about nine-tenths was secured through the Boston members of the board of trustees. To the list of these services to the laboratory must be added the establishment and maintenance of the large dining club, without which the laboratory could not have grown to its present size.

In consideration, then, of these facts, that the plan of providing both for instruction and for investigation, and the continued life of the laboratory, have hitherto depended primarily upon the efforts of the Boston trustees, may it not be claimed that they might reasonably have expected justice and consideration from those who alone had any direct advantage from their efforts.

2. Dr. Whitman was appointed Director and has ably carried out the original plans of the trustees, and though the general plan and scope of the Laboratory have remained unchanged from the start, Dr. Whitman has suggested and carried through valuable modifications and he has devoted his summers and other time to the Laboratory for nine years, and has served through the whole period without remuneration. Under these circumstances the trustees have always striven to meet Dr. Whitman's wishes in every practical way, and have repeatedly laid aside their own preferences and convictions in order to give the Director the fullest expression of their recognition of his services. There gradually arose, however, a serious divergence of views upon important points between Dr. Whitman, upon the one hand, and the trustees, as recorded by the votes and discussions of the board, on the other.

The first point related to the general policy of the Laboratory. A large majority of all the trustees who have ever attended a meeting were convinced that the wisest course was to plan at once a permanent building, with first-class equipment, and to endeavor to secure a permanent endowment. Dr. Whitman wished first to erect more temporary buildings, although the debt of the Laboratory was thereby increased. Out of deference to Dr. Whitman the Board yielded more than once, but last winter they showed a positive determination not to sanction the continuation of the policy.

The second point concerned the financial management. The trustees held that it was their duty to exercise an effective control of the finances, in accordance with their legal obligation under the act of incorporation, and, therefore, that they must regulate the general appropriations, such as those for salaries, for running expenses, etc. Dr. Whitman, on the contrary, apparently considered that the expenditures were to be regulated solely by him, and acted accordingly. He exceeded his appropriations for running expenses and spent money necessary for certain uses for an unauthorized purpose. The trustees adopted the most generous and lenient view possible of these occurrences, for they attributed them to Dr. Whitman's ignorance of the ordinary rules of financial administration, until the violations became so extreme that it was unavoidable to take prompt and efficient steps to protect the Laboratory.

The following instances illustrate the character of Dr. Whitman's financial standards. In his report for 1895, p. 28, he presents figures to show that each time the trustees acceded to his wish for a new building the earnings of the Laboratory increased faster than the expenses. But Dr. Whitman's statement of the expenses for five of the eight years was extremely incorrect,* as shown in the following table:

* It is to be regretted that the errors were not observed in time to withdraw them from publication.

Year.	Dr. Whitman's Figures.	Actual Figures.*
1888	$1320.	$2205.
1889	1554.	2377.
1890	2430.	3041.
1891	3498.	3346.
1892	4132.	4049.
1893	4264.	4110.
1894	4882.	6940.
1895	8010.	8474.

He failed also to note that with each new building, since 1891, the confidence in the Laboratory diminished and thereafter the gifts to the institution decreased.

Year.	New Building.	Gifts.
1888	(first)	$9926
1889	——	5400
1890	one	2984
1891	——	5875
1892	one	5113
1893	one	3613
1894	one	2977
1895	——	2368
1896	one	1122
1897	——	1651†

As an illustration of Dr. Whitman's views as to the finances of the Laboratory, he maintained that the last new building paid for itself because the rooms were occupied, but was unable to recognize that he had used the privilege of inviting guests to the Laboratory so liberally that if these workers, who paid nothing, had been dropped, the extra rooms provided in the new building would have been unnecessary. The charge for an investigator's room is $100. The number of non-paying guests invited by Dr. Whitman was fourteen in 1896 and eleven in 1897.

Again, last winter the Laboratory was in debt, a debt which the trustees were obliged to meet. The Assistant Director held certain sums which he had collected from sales of supplies. The Treasurer called in these sums, but was met by a refusal because the Assistant Director had been told by Dr. Whitman to retain the money, subject to his order.

Other illustrations of the embarrassments caused by Dr. Whitman in the financial management of the Laboratory might be enumerated.

The lack of financial ability, demonstrated by the Director, rendered it in the judgment of the Trustees, imperative to protect the interests of the Laboratory. The Trustees therefore appointed a trained business man as Bursar, who received orders to pay all bills approved by Dr. Whitman, up to the limit of the appropriations. The Bursar proved very efficient and satisfactory, and furnished the trustees with clear and definite summaries of the receipts and expenditures during the summer.

3. The trustees as a body were desirous of making the Laboratory a truly national institution, while Dr. Whitman apparently wished to convert it into an organization under his own exclusive control. The trustees decided to insist upon their authority as the fulfilment of a trust confided to them by the subscribers to the funds of the Laboratory.

At the close of the session of 1896 the trustees were confronted by a deficit of about $1,500,* according to the written official statement of the Treasurer. This deficit was due to two causes: *first*, Dr. Whitman had greatly exceeded the income at his disposal; *second*, he used nearly $400 necessary for covering the running expenses, and spent it for an unauthorized purpose, disregarding a vote of the trustees.

He justified this act by stating, afterwards, that Mr. Nunn had promised this sum for that use. To offset this deficiency the trustees had only certain expected fees

*Compiled from the Treasurer's Reports. As certain items, such as postage, printing, etc., which represent regular annual expenses are not included, several of these amounts are less than they should be.

†Includes Mr. Nunn's payment of $398.

*The exact amount could not be given, as certain bills had not been sent in.

for the past season, but these belated fees, amounting last year to several hundred dollars, it has been the custom to reserve to cover the expenses of opening the Laboratory the following season. Under these conditions it was impossible to plan to open the Laboratory until funds were secured to cover the deficit, and Dr. Whitman was so informed. The Laboratory had, in addition, a debt of about $5,500. After several months the $398.59 used by Dr. Whitman was restored to the treasury by a payment made for that purpose by Mr. Nunn. The trustees applied all the fees they could collect to cover the deficit and finally raised in Boston $1,144, and thereupon immediately made public announcement of the opening of the Laboratory.

Dr. Whitman, who was the cause of these difficulties, and therefore of the delay in issuing the announcement for 1897, blamed the trustees not only for their conservatism, but also for that delay and for the appointment of a Bursar, which his deficiencies had rendered indispensable.

A written offer was received in April, 1897, from Mr. L. L. Nunn, of Telluride, Colorado, a brother-in-law of the Director and one of the trustees of the Laboratory since January, 1896. This offer substantially was as follows:

Mr. Nunn offered to pay the deficit in the running expenses at Wood's Holl for the season of 1897, after devoting towards the payment of such expenses all proceeds obtained from the operations at Wood's Holl. These running expenses did not include insurance, interest on the debt, or the expenses of the Treasurer's office. The offer was made upon the condition that Dr. Whitman directed the Laboratory in accordance with his best judgment and that Mr. Allen, 'or some other person acceptable to me' (Mr. Nunn's words), be employed as Assistant Treasurer at Wood's Holl. Mr. Nunn made himself responsible only for expenses incurred with consent of said Assistant Treasurer or himself.

It is to be noted that Mr. Nunn offered an uncertain amount and made no promise of subsequent assistance, but did state expressly to the trustees, at a meeting, that no large gift could be expected from him. As the acceptance of this offer was conditional on the discharge of the Bursar already engaged by the trustees, and as the trustees did not consider it wise to relinquish all responsibility, even for a limited time, to one of their number, Mr. Nunn's proposition was declined by a recorded vote of nine to one, and the decision was communicated to him by the Treasurer in the following terms:

April 15th, 1897.

L. L. NUNN, Esq.,

Dear Sir:

I have your letter of April 9th from Provo, Utah, enclosing draft of your offer to the Trustees of the Marine Biological Laboratory.

The Trustees, after giving your generous offer careful consideration since your visit to Boston, and after a meeting at which the subject was fully discussed, were with one exception of the opinion that it would not be compatible with their duties as Trustees of the Laboratory, to resign into the hands of Dr. Whitman the entire direction of its policy, even though guaranteed by you against any financial loss during the coming season.

Your first letter and draft were never received by me; I presume they miscarried in the mail, and your second letter did not arrive until after the meeting, but I do not find anything in it which materially differed from the proposition as originally made to the Trustees by word of mouth. I shall transmit your letter and offer to the Secretary, in order that they may be submitted to the Trustees at their next meeting, but I think we may regard the matter as definitely settled without awaiting further action.

Personally, I believe that the decision of the Trustees was a necessary one; at the same time, I confess to great reluctance in foregoing on behalf of the Laboratory your generous assistance, and we must certainly all be very grateful to you for the interest you have taken in our project.

Yours truly,

LAURENCE MINOT.

4. The customary summer meeting of the

board of trustees was held at Wood's Holl on August 6, 1897. At this meeting only a small attendance is expected, as it is known that many members are usually absent on expeditions or vacations, and, accordingly, until this year only routine business had been transacted at this meeting. Before this meeting began, Dr. Whitman stated, deliberately, to the Acting President in response to a question, that there was no important new business to be brought forward. After the hour of the meeting the four members of the board who had come from Boston to attend were kept waiting half an hour for the arrival of the other members who were then at Wood's Holl, although it was known that most of the Boston trustees must return by the last train in two hours. On the motion of Dr. E. G. Gardiner some 150 new members of the corporation were elected, most of them students at the Laboratory. Without this election it is doubtful if the subsequent plans could have been carried through. After all the business known to the President and Secretary had been transacted, Dr. Whitman introduced an extended discussion on some matters of the past (about which no action was possible). Almost immediately thereafter it became necessary for three members to leave to take the last train to Boston, and a protest against continuing the meeting was made but was overridden. The meeting was continued by Dr. Whitman, Dr. E. G. Gardiner, Professor J. P. McMurrich, Professor S. F. Clarke and the Secretary, who remained. The proposition to hold the annual meeting at Wood's Holl, a piece of important new business, for which there had previously been ample opportunity was then brought forward, and the following votes were passed, the Secretary voting in the negative in each case. The Secretary also made strong protests against passing so revolutionary measures after the Acting President and two trustees had left the meeting.

Voted on the motion of Dr. E. G. Gardiner: That the clerk be directed to call a special meeting of the corporation to consider the advisability of changing the by-laws, the meeting to be held at the Parker House, Boston, on August 16th.

Voted: That the temporary chairman (Professor McMurrich) appoint a committee of three to formulate the changes in the by-laws.

The committee was constituted with Dr. Gardiner, chairman; Dr. Whitman and Professor Clarke.

The purpose of the proposed changes was to have the annual meetings of the corporation held at Wood's Holl, to change the board of trustees from a body practically self-perpetuating to an elective body, and to place the control of the Laboratory in new hands.

We consider the action taken entirely unjustifiable, owing to the methods employed. There are also special reasons which made it unsuitable for Dr. Whitman and for Dr. Gardiner and Professor McMurrich to pursue the course taken.

In his Report for 1895, p. 47, Dr. Whitman says: "It still remains possible for a minority of four to hold meetings at convenience in Boston and regulate the affairs of the Laboratory, and that, too, in the absence of every one familiar with the needs. It makes no difference whether this has or has not been done; the possibility of its being done is what jeopardizes vital interests of the Laboratory."

We call attention to the fact that Dr. Whitman, aided by Messrs. Gardiner, McMurrich and Clarke, is the first and only person who has profited by the possibility he so emphatically condemned, and that, by utilizing it, he and his three supporters succeeded in setting aside the expressed wishes of the board of trustees, and in changing

the national character of the Laboratory.

In August 1895, the trustees appointed a committee 'to take into consideration a reorganization of the governing body.' In 1896 Dr. Gardiner was made chairman of this committee, of which Professor McMurrich was also a member. A resolve proposing certain changes in the mode of government of the Laboratory, introduced by one of the trustees, was referred to the committee.

We regret that the committee, in spite of many repeated requests to its chairman, made no report, and that Dr. Gardiner and Professor McMurrich, instead of acting in consultation with their fellow trustees, adopted a plan to reorganize the government of the Laboratory by other means.

5. The special meeting was duly held at the Parker House, Boston, on August 16th. A large attendance from Wood's Holl was secured, it is said, by hiring a special car and offering to pay the fares of the members of the Corporation, many of whom had been elected only a few days before. It was proposed by some of the Boston trustees to ask for a hearing before this meeting, but the gathering seemed to them so evidently packed that they considered any attempt to obtain a hearing useless. The proposed changes in the by-laws were carried through. The most important one of these is that which fixes the annual meeting for the summer at Wood's Holl. This change seems well calculated to enable the Director to maintain practically control over the Corporation. Other changes made are likely also to favor this result.

The newly appointed annual meeting of the Corporation was held at Wood's Holl on August 24th. A new board of trustees was elected and five of the Boston trustees were dropped. The Boston trustees could make no defense, because they had never heard any accusations and had no information until the meeting of their projected exclusion. Moreover, nearly all the undersigned were necessarily absent from that meeting.

Although without the labors of the five trustees who were dropped from the board the Laboratory might never have existed, and although Dr. Whitman was under many obligations to them, they were ejected from the board by means which can only be considered underhand and dishonorable. We believe that such a policy must injure the Laboratory seriously and we are unable to give it support or approval.

The main points of this statement are as follows:

1. The recognition of the scientific ability of the Director, his devotion and services to the Laboratory.

2. The utter lack of sound financial standards shown by the Director.

3. The dishonorableness of the methods employed to reorganize the government of the Laboratory.

4. The ignorance of the facts on the part of the members of the Corporation present at the meetings of August 16th and 24th, which helped to make this reorganization possible.

SAMUEL H. SCUDDER,
President, 1891–96;
WILLIAM G. FARLOW,
Acting President, 1896–97;
ANNA P. WILLIAMS,
Secretary, 1888–97;
LAURENCE MINOT,
Treasurer, 1894–97;
CHARLES S. MINOT,
Trustee, 1888–97;
GEORGIANA W. SMITH,
Trustee, 1891–97;
SIDNEY I. SMITH,
Trustee, 1891–97.

THE JESUP EXPEDITION TO THE NORTH PACIFIC COAST.

IT will be remembered that in the spring of this year Mr. Morris K. Jesup, President of the American Museum of Natural History, provided the means for a thorough ethnological investigation of the northern portions of the Pacific coasts of Asia and North America.

It was decided to begin field work on the American coast, and in May a party consisting of Dr. Franz Boas, Dr. Livingston Farrand and Mr. Harlan I. Smith left New York in order to carry on anthropological investigations in British Columbia. In previous years the Committee of the British Association for the Advancement of Science appointed for studying the tribes of northwestern Canada had carried on investigations in British Columbia. This committee was about to conclude its field work. Since the territory in which the operations of the Jesup Expedition are to be conducted embraces the field of work of the committee, it seemed desirable to have the operations of both parties conducted on a common plan. The committee was desirous of completing its anthropometric survey of British Columbia and to obtain information on the Tinneh tribes of the interior of that Province. This work was entrusted to the party of the Jesup Expedition and has been done by Dr. Farrand and Dr. Boas.

During the past season the work of the Jesup Expedition was directed mainly to an exploration of the prehistoric remains of British Columbia, to a study of the Bella Coola Indians and of the northern Kwakiutl Indians. A special study of the art of the Indians of the North Pacific coast was included in the plan of work. In all these directions good progress has been made. The work was divided in the following way. Mr. Smith was charged with the archæological investigations; Dr. Boas and Dr. Farrand collected anthropometrical data, and Dr. Farrand undertook the study of the Chilcotin for the British Association for the Advancement of Science, and later on carried on inquiries on the sociology of the northern Kwakiutl. Dr. Boas investigated the Bella Coola Indians and later on studied the art of the northern tribes. He concluded his work with a study of the language of the northern Kwakiutl. In British Columbia Mr. James Teit and Mr. George Hunt joined the party, the former to assist in work on the Thompson River Indians, the latter to assist in work among the Kwakiutl tribes. Mr. Teit has promised to furnish for the expedition a description of the Thompson River Indians. Mr. Hunt's services were of the greatest value on account of his intimate knowledge of the Kwakiutl language and of the customs of the people.

The result of this summer's work may be summarized as follows: Mr. Smith investigated archæological remains at four points: at Kamloops, Spence's Bridge, at the famous burial ground at Lytton and at Port Hammond.

The remains found at Kamloops belong to a number of periods preceding contact with the whites. In all the sites objects made of shell, copper, bone and stone were found. The general shape of these objects suggest that the people using them were the immediate ancestors of the tribes inhabiting these regions at the present day. Most of the material was found buried in shifting sand, owing to which fact the original order has been much disturbed.

The remains found at Lytton were of a character similar to those found at Kamloops. While a thorough investigation of the finds may show that there existed differences in the cultures of these regions, the general characteristics of the material are much alike. In both places the

finds were made in ancient burials or in caches.

At Port Hammond Mr. Smith investigated a number of shell heaps. These have a thickness of $4\frac{1}{2}$ feet or less, and the remains found in the heaps were ascertained to be not intrusive. A number of skeletons and well-preserved artefacts were found. There is no difference in the character of the objects found in the lowest layers and in the higher layers. Judging by the size of trees growing on the shell heaps, these sites must have been deserted for a considerable length of time, but there is no evidence pointing to a very great antiquity of the remains. Further conclusions cannot be drawn until the material obtained in these localities has been subjected to a thorough investigation.

Dr. Boas' investigations on the Bella Coola gave some results of considerable interest. Previous inquiries had shown that the Bella Coola possess a highly developed mythology. Further studies have shown that they are the only tribe on the North Pacific coast that have systematized their mythology. While among them we find most of the elements of the mythologies of the neighboring tribes, this material has been so elaborated that instead of a multitude of spirits we find a number of deities, each with its proper functions. The Bella Coola believe that there are five worlds, an upper heaven over which rules the supreme goddess Qamaits. The lower heaven is the home of a number of deities, the most powerful of whom is the sun, called by the Bella Coola 'Our Father' and 'The Sacred One.' The deities reside in a house located in the zenith. It is called 'House of Myths.' The thoughts of these deities are put into action by four brothers, who live in a separate room in the rear of the house. Here also reside ten brothers, to whose care the winter ceremonial is entrusted. The sun walks from east to west every day. In the east in heaven sits the 'Bear of Heaven,' watching the 'Place of Dawn.' On the west is the pillar, which prevents the sun from passing into the lower world. Twenty-four watchmen are appointed to look after the sky and to keep it in good order. Three others fly around the sun watching his course. At winter solstice and summer solstice are stationed two watchmen, whose duty it is to prevent his tarrying at those places. Our own world—the earth—is an island in the ocean. In the far east a god is sitting, who holds a strong bar in both his hands. Stone ropes are tied to this bar by means of which the earth is held in place. In the far west is the salmon land. The world underneath ours is that of the ghosts. Everything there is the reverse of what it is here. The ghosts walk on their heads. When it is winter here it is summer there, When it is daylight here it is night-time there. The deceased may return to life by being born again. When a ghost dies his soul goes to the lowest world, from which there is no return. The year is divided into two periods. In summer the 'canoe of the salmon' stays in our world. In October it returns to the salmon country and at the same moment the 'canoe of the winter ceremonial' arrives. As soon as this canoe reaches the banks of the river the whole tribe embark and are conveyed to the 'House of Myths,' in heaven. At the same time the female spirit of the winter ceremonial, of which there is one for each village, leaves her abode in the mountains and shows herself. At the time of the winter solstice the 'canoe of the winter ceremonial' returns and the 'canoe of the salmon' arrives from the salmon country. These mythological ideas are the foundation of the calendar of the people, which has twelve months, two indefinite periods around the solstices and five months between the solstices.

The traditions of the Bella Coola are, to a great extent, totemic. Only members of the clan have the right to relate their traditions and to use the carvings based on their traditions. This has led to a system of endogamic marriage which was intended to prevent the acquisition of clan rights by other clans. This system is breaking down under the influence of the Kwakiutl system of exogamic marriage.

Investigations on the art of the Indians were mainly based on the consideration that the process of conventionalization will probably progress the farther the more difficult the treatment of the surface to be decorated. It seemed that no surface offers greater difficulties than the human face, and for this reason a considerable number of facial paintings were collected. The results of this collection met the expectations, since a number of highly conventionalized designs, some of purely geometrical character, were obtained. In addition to these a number of designs from house fronts and from edges of blankets were obtained.

The studies on the languages of the Kwakiutl Indians cannot very well be summarized in a few words. Texts were obtained in two dialects, the Awikyenok and the Kwakiutl proper, which will probably form a satisfactory basis for a full treatment of these dialects.

On account of the difficulties encountered in previous work on the physical characteristics of the tribes, it was deemed desirable to base the work on better material. Previous collections consisted of measurements and brief descriptive notes of types. These latter proved to be very unsatisfactory on account of the vagueness of the terms employed. Photographs obviate this difficulty to a certain extent, but not adequately, owing to the effects of perspective forshortening. For this reason it was deemed desirable to try if the subject can be treated more advantageously by means of a systematic collection of plaster casts, which will facilitate comparison. This seemed particularly important, since the study of the physical types of the coast of the North Pacific Ocean must form one of the most important subjects of investigation of the Jesup Expedition. A series of one hundred casts have been obtained, representing four distinct types of British Columbia. The collection will be subjected to a critical examination in order to ascertain the usefulness of the method of investigation. The collection was made by all the members of the party. Each cast is accompanied by four photographs of the subject on a scale of about 1:5, front view, two profiles and one half profile. These photographs were taken by Mr. Harlan I. Smith.

Dr. Farrand, in his work among the Chilcotin, obtained considerable ethnological information, both as regards mythology and general customs. In both these fields striking evidence of the influence of contact with neighboring tribes was found; thus in certain myths details of clearly coast origin, along with those bearing unmistakable marks of the interior, were found grafted upon otherwise independent Chilcotin stories. In social organization the Chilcotin, unlike the Tinneh tribes immediately to the north of them, show few signs of coast influence. No traces of clan organization were seen. Recognized relationship was regarded as a bar to marriage, but this recognition was apparently not carried further than cousins of the first degree. The general condition and habits of the tribe have been greatly changed during the last thirty years, owing to the establishment of reservations upon which most of the people have been settled who thus abandoned the wandering life to which they were formerly accustomed. A few families

still decline to come in to the reservations and keep up their old semi-nomadic life in the mountains.

As to the social organization of the Heiltsuk it was found that the tribe contains four clans—the eagle, wolf, raven and killer whale. There is nothing corresponding to the phratries of tribes farther north, but the individual clans are strictly exogamous, and marriage is also forbidden with members of corresponding clans in certain other tribes. Descent is mixed, maternal and paternal, but preference is shown for the clan of the mother. In the case of a single child it almost invariably takes the maternal clan. There were formerly three social classes—nobility, common people and slaves. The nobility or chiefs were of different ranks, higher position being obtained by means of the potlatch. A member of the lower classes, however, could never obtain nobility.

A very considerable number of specimens were collected by the expedition which will materially increase the scientific value of the collections from the North Pacific coast in the American Museum of Natural History. The new material consists mainly of archæological collections from Kamloops, Lytton and Port Hammond; an ethnological collection from Spence's Bridge, another one from Chilcotin Valley. From the northern part of the coast a very full collection of masks and carvings illustrating mythology of the Bella Coola was obtained. Another collection illustrates the arts and ceremonials of the Kwakiutl and of the Nootka. Finally the large collection of casts and photographs of Indians must be mentioned.

Ethnology is deeply indebted to Dr. Jesup for inaugurating this important investigation, which, we may hope, will help to settle finally a number of the most difficult problems regarding the early history of mankind.

EXPERIMENTAL MORPHOLOGY.*

IN looking at the progress which has been made in the study of plant morphology I have been as much impressed with the different attitudes of mind toward the subject during the past 150 years as by the advance which has taken place in methods of study and the important acquisitions to botanical science. These different view points have coincided to some extent with distinct periods of time. What Sachs in his 'History of Botany' calls the 'New Morphology' was ushered in near the middle of the present century by Von Mohl's researches in anatomy, by Naegeli's investigation of the cell and Schleiden's history of the development of the flower. The leading idea in the study of morphology during this period was the inductive method for the purpose of discerning fundamental principles and laws, not simply the establishment of individual facts, which was especially characteristic of the earlier period when the dogma of the constancy of species prevailed.

The work of the 'herbalists' had paved the way for the more logical study of plant members by increasing a knowledge of species, though their work speedily degenerated into mere collections of material and tabulations of species with inadequate descriptions. Later the advocates of metamorphosis and spiral growth had given an impetus more to the study of nature, though diluted with much poetry and too largely subservient to the imagination or idealistic notions.

But it was reserved for Hoffmeister,† whose work followed within three decades of the beginnings of this period, to add to the

*Address of the Vice-President before Section G—Botany—of the American Association for the Advancement of Science, Detroit, 1897.

† Bibliographical details will be appended when the address is published in the Proceedings of the Association.

inductive method of research as now laid down the comparative method, and extending his researches down into the Pteridophyta and Bryophyta, he not only established for these groups facts in sexuality which Camerarius and Robert Brown had done for the Spermatophyta, but he did it in a far superior manner. He thus laid the foundation for our present conceptions of the comparative morphology of plants. Naegeli's investigations of the cell had emphasized the importance of its study in development and now the relation of cell growth to the form of plant members was carried to a high degree, and an attempt was made to show how dependent the form of the plant was on the growth of the apical cell in the Pteridophyta and Bryophyta, though later researches have modified this view, and how necessary a knowledge of the sequence of cell division was to an understanding of homologies and relationships. Thus in developmental and comparative studies morphology has been placed on a broader and more natural basis, and the homologies and relationships of organs between the lower and higher plants are better understood.

But the growth of comparative morphology has been accompanied by the interpretation of structures usually from a teleological standpoint, and in many cases with the innate propensity of the mind to look at nature in the light of the old idealistic theories of metamorphosis.

I wish now to enquire if we have not recently entered upon a new period in our study of comparative morphology. There are many important questions on which comparative studies of development under natural or normal conditions alone cannot afford a sufficient number of data. We are constantly confronted with the problems of the interpretation of structure and form, not only as to how it stands in relation to structures in other plants which we deal with in comparative morphology, but the meaning of the structure or form itself, and in relation to the other structures of the organism, in relation to the environment and in relation to the past. This must be met by an enquiry on our part as to why the structure or form is what it is, and what are the conditions which influence it. This we are accustomed to do by *experiment*, and it begins to appear that our final judgments upon many questions of morphology, especially those which relate to variation, homology, etc., must be formed after the evidence is obtained in this higher trial court, that of *experimental morphology*. While experimental morphology as a designation of one branch of research in plants, or as a distinct and important field of study, is not yet fully taken cognizance of by botanists, we have only to consult our recent literature to find evidence that this great and little explored field has already been entered upon.

Experimental methods of research in the study of plants have been in vogue for some time, but chiefly by plant physiologists and largely from the standpoint of the physical and chemical activities of the plant, as well as those phases of nutrition and irritability, and of histologic structure, which relate largely to the life processes of the plants, and in which the physiologist is therefore mainly interested. In recent years there has been a tendency in physiological research to limit the special scope of these investigations to those subjects of a physical and chemical nature. At the same time the study of the structure and behavior of protoplasm is coming to be regarded as a morphological one, and while experimental methods of research as applied to the morphology of protoplasm and the cell is comparatively new there is already a considerable literature on the subject, even from the side of plant organisms (Davenport, '97). While certain of the

phenomena of irritability and growth are closely related to the physics of plant life, they are essentially morphologic, and it is here especially that we have a voluminous literature based strictly on the inductions gained by experimentation, and for which we have chiefly to thank the plant physiologists.

If we were to write the full history of experimental morphology in its broadest aspects we could not omit those important experimental researches on the lower plants in determining the ontogeny of polymorphic species among the algæ and fungi which were begun so ably by DeBary, Tulasne, Pringsheim and others and carried on by a host of European and American botanists. The tone which these investigations gave to taxonomic botany has been felt in the study of the higher plants, by using to some extent the opportunities at botanic gardens, where plants of a group may be grown under similar conditions for comparison, and in the establishment of alpine, subalpine and tropical stations for the purpose of studying the influence of climate on the form and variations of plants, and in studying the effect of varying external conditions.

While experimental morphology in its broadest sense also includes in its domain cellular morphology and the changes resulting from the directive or taxic forces accompanying growth, it is not these phases of morphology with which I wish to deal here.

The question is rather that of experimental morphology as applied to the interpretation of the modes of progress followed by members and organs in attaining morphologic individuality, in the tracing of homologies, in the relation of members associated by antagonistic or correlative forces, the dependence of diversity of function in homologous members on external and internal forces, as well as the causes which determine the character of certain paternal or maternal structures. I shall deal more especially with the experimental evidence touching the relation of the members of the plant which has been represented under the concept of the leaf as expressed in the metamorphosis theory of the idealistic morphology. The poetry and mystery of the plant world, which was so beautifully set forth in the writings of Goethe and A. Braun, are interesting and entrancing, and the poetic communication with nature is elevating to our ethical and spiritual natures. But fancy or poetry cannot guide us safely to the court of inquiry. We must sometimes lay these instincts aside and deal with nature in a cold, experimental, calculating spirit.

The beginnings of experimental morphology were made about one century ago, when Knight, celebrated also for the impulse which he gave to experimental physiology, performed some very simple experiments on the potato plant. The underground shoots and tubers had been called roots until Hunter (77) pointed out the fact that they were similar to stems. Knight tested the matter by experiment, and demonstrated that the tubers and undergound stems could be made grow into aërial leafy shoots. This he regarded as indicating a compensation of growth, and he thought farther that a compensation of growth could be shown to exist between the production of tubers and flowers on the potato plant. He reasoned that by the prevention of the development of the tubers the plant might be made to bloom. An early sort of potato was selected, one which rarely or never set flowers, and the shoots were potted with the earth well heaped up into a mound around the end of the shoot. When growth was well started the soil was washed away from the shoot and the upper part of the roots so that the plant was only connected with the soil by the roots. The

tubers were prevented from growing and numbers of flowers were formed. This result he also looked upon as indicating a compensation of growth between the flowers and tubers. While we recognize Knight's experiments as of great importance, yet he erred in his interpretation of the results of this supposed correlation between the tubers and flowers, as Vöchting has shown. By repeating Knight's experiment, and also by growing shoots so that tubers would be prevented from developing, while at the same time the roots would be protected, flowers were obtained in the first case while they were not in the second, so that the compensation of growth, or correlation of growth, here exists between the vegetative portion of the plant and the flowers instead of between the production of tubers and flowers as Knight supposed.

The theory of metamorphosis as expressed by Goethe and A. Braun ('51) and applied to the leaf regarded the leaf as a *concept* or *idea*. As Goebel ('80) points out, Braun did not look upon any one form as the typical one which through transformation had developed the various leaf forms, but each one represented a wave in the march of the successive billows of a metamorphosis, the shoot manifesting successive repetitions or renewals of growth each season, presenting in order the 'niederblätter, laubblätter, hochblätter, kelchblätter, blumenblätter, staubblätter, fruchtblätter. Though it had been since suggested from time to time, as Goebel ('80) remarks, that the foliage leaf must be regarded as the original one from which all the other forms had arisen (though at that time Goebel did not think this the correct view), no research, he says, had been carried on, not even in a single case to determine this point. Goebel plainly showed in the case of *Prunus padus* that axillary buds which under normal conditions were formed one year with several bud scales could be made by artificial treatment to develop during the first year. This he accomplished by removing all the leaves from small trees in April, and in some cases also cutting away the terminal shoot. In these cases the axillary shoot, instead of developing a bud which remained dormant for one year as in normal cases, at once began to grow and developed well-formed shoots. Instead of the usual number of bud scales, there were first two stipule-like outgrowths, and then fully expanded leaves were formed, so that in this case, he says, the metamorphosis of the leaf to bud scales was prevented. For this relation of bud scales to foliage leaves Goebel proposed the term 'correlation of growth' ('80). In the case of *Vicia faba* removal of the lamina of the leaf of seedlings when it was very young caused the stipules to attain a large size and to perform the function of the assimilating leaf. He here points out that experimentation aids us in interpreting certain morphological phenomena which otherwise might remain obscure. He cites the occasional occurrence (Moquin-Tandon) in the open of enlarged stipules of this plant which his experiment aids in interpreting. In the case of *Lathyrus aphaca* the stipules are large and leaf-like, while he part which corresponds to the lamina of the leaf is in the form of a tendril, the correlation processes here having brought about the enlargement of the stipules as the lamina of the leaf became adapted to another function. Kronfeld ('86, '87) repeated some of Goebel's experiments, obtaining the same results, and extended them to other plants (*Pirus malus* and *Pisum sativum*), while negative results attended some other experiments. Hildebrand, in some experiments on seedlings and cuttings, found that external influences affected the leaves, and in some cases, where the cotyledons were cut, foliage leaves appeared in place of the usual bud scales, and in *Oxalis rubella* removal of the

foliage leaf, which appears after the cotyledons, caused the first of the bulb scales, which normally appear following the foliage leaf, to expand into a foliage leaf.

In some experiments on the influence of light on the form of the leaves Goebel ('96) has obtained some interesting results. Plants of *Campanula rotundifolia* were used. In this species the lower leaves are petioled and possess broadly expanded, heart-shaped laminæ, while the upper leaves are narrow and sessile, with intergrading forms. Plants in different stages of growth were placed in a poorly-lighted room. Young plants which had only the round leaves under these conditions continued to develop only this form of leaf, while older plants which had both kinds of leaves when the experiment was started now developed on the new growth of the shoot the round-leaved form. In the case of plants on which the flower shoot had already developed, side shoots with the round leaves were formed. Excluding the possibility of other conditions having an influence here, the changes in the form of the leaves has been shown to be due to a varying intensity of light. The situation of the plants in the open favor this view, since the leaves near the ground in these places are not so well lighted as the leaves higher up on the stem. In this case the effect of dampness is not taken into account by the experimenter, and, since dampness does have an influence on the size of the leaf, it would seem that it might be at least one of the factors here. An attempt was now made to prevent the development of the round leaves on the young seedlings. For this purpose the germinating seeds were kept under the influence of strong and continuous lighting. The round leaves were nevertheless developed in the early stage, an indication that this form of the leaf on the seedling has become fixed and is hereditary. Hering ('96) found that enclosing the larger cotyledon of *Streptocarpus* in a plaster cast, so as to check the growth, the smaller and usually fugacious one grew to the size of the larger one, provided the experiment was started before the small one was too old. Amputation of the large cotyledon gave the same results.

Other experimenters have directed their attention to the effect of light and gravity on the arrangement of the leaves on the stem, as well as the effect of light on the length of the petioles and breadth of the lamina. Among these may be mentioned the work of Weisse ('95), Rosenvinge ('94), and others.

Goebel has shown experimentally that dampness is also one of the external influences which can change the character of xerophyllous leaves. A New Zealand species of *Veronica* of xerophyllous habit and scaly appressed leaves in the seedling stage has spreading leaves with a broad lamina. Older plants can be forced into this condition in which the leaves are expanded by growing them in a moist vessel ('96). Gain, Askenasy and others have shown that dampness or dryness has an important influence in determining the character of the leaves.

The results of the experiments in showing the relation of the leaf to the bud scales Goebel regards as evidence that the foliage leaf is the original form of the two, and that the bud scale is a modification of it.

Treub ('72) conducted some interesting experiments for the purpose of determining the homology of the pappus of the Compositæ. Gall-insects were employed to stimulate the pappus of *Hieracium umbellatum*, and it was made to grow into a normal calyx with five lobes. (A recent letter from Professor Treub states that he later repeated these experiments with other species of Compositæ with like results, but the work was not published.) Kny ('94) found in seedlings and cuttings which he experimented with that, while there was still

stored food available for the roots and shoots, there was little, if any, dependence of one upon the other. Hering ('96) comes to somewhat different conclusions as a result of his experiments, finding that in some cases there was a slight increase of growth, while in others growth of the one was reciprocally retarded when the other was checked in development. Numerous cases of horticultural practice in pollination of fruits show that the form and size of the fruit and of the adjacent parts, as well as the longer or shorter period of existence of the floral envelopes, can be influenced by pollination.

The investigations carried on by Klebs ('96) in the conjugation of *Spirogyra* suggest how experimentation of this kind may be utilized to determine questions which in special cases cannot be arrived at easily by direct investigation. If threads of *Spirogyra varians* which are ready for conjugation are brought into a (0.5%) solution of agar-agar, in such a way that nearly parallel threads lie at a varying distance in their windings, where they are within certain limits, the conjugation tubes are developed and the zygospores are formed; but where the threads lie at too great a distance for the influence to be exerted, the cells remain sterile, and no conjugation tubes are developed. If, now, these threads be brought into a nutrient solution, these cells, which were compelled to remain sterile, grow and develop into new threads, *i. e.*, they take on the vegetative, though they are fully prepared for the sexual function. Strasburger ('97) has pointed out that this may be taken as excluding the possibility of there being a reducing division of the chromosomes during the maturing of the sexual cells, a process which takes place in animals, and that the behavior of *Spirogyra* in this respect agrees with what is known to take place in the higher plants, viz., that the reduction process is not one which is concerned in the maturity of the gametes. The same could be said of *Polyphagus*, in which Nowakowski ('78) found that before the zygospore was completely formed the protoplasm moved out and formed a new sporangium.

In the case of *Protosiphon botryoides* Klebs was also able to compel the parthenogenetic development of the motile gametes, and the same thing was observed in the case of the gametes of *Ulothrix*. If we are justified in interpreting this phenomenon as Strasburger suggests, the evidence which Raciborski ('96) gives as a result of his experiments with *Basidiobolus ranarum* would support the idea that there is no reducing division in the chromosomes before the formation of the nuclei of the gametes. Raciborski found that in the case of the young zygospores of this plant, in old nutrient medium where the fusion of the plasma contents had taken place, but before the nuclei had fused, if they were placed in a fresh nutrient medium the fusion of the nuclei was prevented, and vegetative growth took place, forming a hypha which possessed two nuclei, the paternal one and the maternal one. Raciborski interprets Eidam's ('87) study of the nuclear division prior to the copulation of the gametes as showing that the reducing division takes places here as in the maturation of the sexual cells of animals, and looks upon the premature germination of the zygospore as showing that a paternal and maternal nucleus possesses the full peculiarities of a normal vegetative one. However, we are not justified in claiming a reducing division for the nuclei preceding the formation of the gametes in *Basidiobolus* from the work of Eidam, since he was not able to obtain sufficiently clear figures of the division to determine definitely how many divisions took place, to say nothing of the lack of definite information as to the number of chromosomes. Fairchild ('96)

has recently studied more carefully the nuclear division, but on account of the large number of the chromosomes was not able to determine whether or not a reduction takes place. He points out, as others have done, the similarity in the process of the formation of the conjugating cells of *Basidiobolus* and *Mougeotia* among the *Mesocarpeæ*, and to these there might be added the case of *Sirogonium* in which the paternal cell just prior to copulation undergoes division. The division of the copulation cell in *Basidiobolus, Mougeotia, Sirogonium*, etc., suggest at least some sort of preparatory act, but whether this is for the purpose of a quantitative reduction of the kinoplasm, as Strasburger thinks sometimes takes place, or is a real reduction in the number of the chromosomes, must be determined by further study, so that the bearing of these experiments on the question of a reducing division must for the time be held in reserve.

One of the very interesting fields for experimental investigation is that of the correlation processes which govern the morphology of the sporophylls (stamens and pistils) of the Spermatophyta. One of the controlling influences seems to be that of nutrition, and in this respect there is some comparison to be made with the correlative processes which govern the determination of sex in plants.

Among the ferns and some others of the Pteridophyta a number of experiments have been carried on by Prantl, Bauke, Heim ('96), Buchtien ('87) and others to determine the conditions which influence the development of antheridia and archegonia. Prantl found that in prothallia of the ferns grown in solutions lacking nitrogen there was no meristem and consequently no archegonia, while antheridia were developed, but if the prothallia were changed to solutions containing nitrogen, meristem and archegonia were developed. All the experiments agree in respect to nutrition; with scanty nutrition antheridia only were developed, while with abundant nutriment archegonia were also developed. Heim studied the influence of light and found that fern prothallia grow best with light of 20%–25%. Exclusion of the ultra violet rays does not affect the development of the sexual organs. He argues from this that the ultra violet rays are not concerned in the elaboration of the material for flower production as Sachs had suggested. In yellow light the prothallia grew little in breadth; they also grew upward, so that few of the rhizoids could reach the substratum. Antheridia were here very numerous. After seven months these prothallia were changed to normal light, and in four months afterward archegonia were developed.

Among the algæ Klebs ('96) has experimented especially with *Vaucheria*, such species as *V. repens* and *V. ornithocephala*, where the antheridia and oogonia are developed near each other on the same thread. With weak light, especially artificial light, the oogonium begins first to degenerate. He never succeeded in suppressing the antheridia and at the same time in producing oogonia.

High temperature, low air pressure or weak light tend to suppress the oogonia, and at the same time the antheridia may increase, so that the number in a group is quite large, while the oogonium degenerates or develops vegetatively. Klebs concludes from his experiments that the causes which lie at the bottom of the origin of sex in *Vaucheria*, as in other organisms, are shrouded in the deepest mystery. In the higher plants a number of experiments have been carried on for the purpose of learning the conditions which govern the production of staminate and pistillate flowers, or, in other words, the two kinds of sporophylls. From numerous empirical observations on

diœcious Spermatophyta, the inference has generally been drawn that nutrition bears an important relation to the development of the staminate and pistillate flowers; that scanty nutrition produces a preponderance of staminate plants, while an abundance of nutrition produces a preponderance of pistillate plants. For a period covering three decades several investigators have dealt with this question experimentally, notably K. Müller ('64), Haberlandt ('75, '77) and Hoffmann ('85). These experiments in general give some support to the inferences from observations, yet the results indicate that other influences are also at work, for the ratios of preponderance either way are not large enough to argue for this influence alone. In a majority of cases thick sowings, which in reality correspond to scanty nutrition, tend to produce staminate plants; while thin sowings tend to produce pistillate plants. In the case of the hemp (*Cannabis sativa*) Hoffmann found that these conditions had practically no influence. He suggests that the character of each may have been fixed during the development of the seed, or even that it may be due to late or early fecundation ('71).

In monœcious plants it has often been observed that pistillate flowers change to staminate ones and *vice versa*, and in diœcious plants pistillate ones sometimes are observed to change to staminate ones (the hemp, for example; see Nagel, 1879). K. Müller ('64) states that by scanty nutrition the pistillate flowers of *Zea mays* can be reduced to staminate ones.

Among the pines what are called androgynous cones have in some instances been observed. In *Pinus rigida* and *P. thunbergii*, for example, they occur (Masters ('68). Matsuda ('92) has described, in the case of *Pinus densiflora* of Japan, pistillate and androgynous flowers, which developed in place of the staminate flowers, and conversely staminate and androgynous flowers in place of pistillate ones. Fujii ('95) has observed that where the pistillate or androgynous flowers of *Pinus densiflora* occur in place of the staminate ones they are usually limited to the long shoots which are developed from the short ones of the previous year. The proximity of these transformed short shoots (Kurztriebe) to injuries of the long ones suggested that the cutting away of the long ones might induce the short ones to develop into long ones and the flowers which were in the position for staminate ones to become pistillate.

Fujii says: "In fact, the injuries producing such effect are frequently given by Japanese gardeners to the shoots of the year of *Pinus densiflora* in their operations of annual pollarding. But the 'Langtrieb' which is transformed from a 'Kurztrieb' of the last year does not necessarily bear female or hermaphrodite flowers in the positions of male flowers." To determine the influence of pollarding of the shoots he carried on experiments on this pine in the spring of 1895. He pollarded the shoots, so as, as he terms it, to induce the nourishment to be employed in the development of the flowers and short shoots near the seat of injury; in other cases one or two shoots were preserved, while all the adjacent shoots of last year's growth at the top of the branch were removed, and, farther, both of these processes were combined. Out of the 45 branches experimented on, and on which there were no signs of previous injury, there were nine pistillate or androgynous flowers in place of staminate ones; in 21 branches with signs of previous injury five were transformed, while in 2,283 not experimented on, and with no signs of previous injury, only seven were transformed. Such abnormal flowers, then, are due largely to the injuries upon the adjacent shoots, and, Fujii thinks, largely to the increased amount of nourishment which is conveyed to them as a result of this.

From the experiments thus far conducted upon the determination of sex in plants or upon the determination of staminate or pistillate members of the flowers, nutrition has at least some influence in building up the nourishing tissue for the two different organs or members. This can in part be explained on the ground that antheridia and staminate members of the plant are more or less short lived in comparison with the archegonia and pistillate members, the latter requiring more bulk of tissue to serve the purpose of protection and nourishment to the egg and embryo. It is thus evident that while some progress has been made in the study of this question we are far from a solution of it. Experiment has proceeded largely from a single standpoint, viz., that of the influence of nutrition. Other factors should be taken into consideration, for there are evidently other external influences and internal forces which play an important rôle, as well as certain correlation processes, perhaps connected with the osmotic activities of the cell sap.

The relation of the parts of the flower to the foliage leaves is a subject which has from time to time called forth discussion. That they are but modifications of the foliage leaf, constituents of the leaf concept, is the contention of the metamorphosis theory, and that the so-called sporophylls are modified foliage leaves, is accepted with little hesitation by nearly all botanists, though it would be very difficult, it seems to me, for any one to present any very strong argument from a phylogenetic standpoint in favor of the foliage leaf being the primary form in its evolution on the sporophyte, and that the sporophyll is a modern adaptation of the foliage leaf. Numerous cases are known of intermediate forms between sporophylls and foliage leaves both in the Spermatophyta and Pteridophyta. These are sometimes regarded as showing reversion, or indicating atavism, or in the case of some of the ferns as being contracted and partially fertile conditions of the foliage leaf. There has been a great deal of speculation regarding these interesting abnormal forms, but very little experimentation to determine the causes or conditions which govern the processes.

In 1894 I succeeded in producing a large series of these intermediate forms in the sensitive fern (*Onoclea sensibilis*). The experiments were carried on at the time for the especial purpose of determining whether in this species the partially developed sporophyll could be made to change to a foliage leaf and yet possess characters which would identify it as a transformed sporophyll. The experiments were carried on where there were a large number of the fern plants. When the first foliage leaves were about 25 cm. high they were cut away (about the middle of May). The second crop of foliage leaves were also cut away when they were about the same height during the month of June. During July, in which time the uninjured ferns were developing the normal sporophylls, those which were experimented upon presented a large series of gradations between the normal sporophyll and fully expanded foliage leaves. Among these examples there are all intermediate stages from sporophylls which show very slight expansions of the distal portion of the sporophyll and the distal portions of the pinnæ, until we reach forms which it is very difficult to distinguish from the normal foliage leaf. Accompanying these changes are all stages in the sterilization of the sporangia (and the formation of prothalloid growths), on some more broadly expanded sporophylls there being only faint evidences of the indusia.

The following year (1895) similar experiments were carried on with the ostrich fern (*Onoclea struthiopteris*) and similar results were obtained. At the time that these experiments were conducted I was unaware of

the experiments performed by Goebel on the ostrich fern. The results he reached were the same; the sporophyll was more or less completely transformed to a foliage leaf. Goebel regards this as the result of the correlation processes, and looks upon it as indicating that the sporophyll is a transformed foliage leaf, and that the experiment proves the reality here of the modification which was suggested in the theory of metamorphosis, and thus the foliage leaf is looked upon by him as the primary form. Another interpretation has been given to these results, viz., that they strengthen the view that the sporophyll, from a phylogenetic standpoint, is primary, while the foliage leaf is secondary. What one interprets as a reversion another regards as indicating a mode of progress in the sterilization of potentially sporogenous tissue and its conversion into assimilatory tissue. It is, perhaps, rather to be explained by the adaptive equipoise of the correlative processes existing between the vegetative and fruiting portions of the plant, which is inherited from earlier times. Rather when spore production appears on the sporophyte could this process be looked upon as a reversion to the primary office of the sporophyte, so that in spore production of the higher plants we may have a constantly recurring reversion to a process which in the remote past was the sole function of this phase of the plant. In this way might be explained those cases where sporangia occur on the normal foliage leaf of *Botrychium*, and some peculiar cases which I have observed in *Osmunda cinnamomea*. In some of the examples of this species it would appear that growth of the leaf was marked by three different periods even after the fundament was outlined, the first a vegetative, second a spore-producing, and third a vegetative again; for the basal portions of the leaf are expanded, the middle portions spore-bearing, the passage into the middle portions being gradual, so that many sporangia are on the margins of quite well-developed pinnæ. These gradations of the basal part of the leaf, and their relation to the expanded vegetative basal portion, showing that the transition here has been from partially formed foliage leaf to sporophyll after the fundament was established, and later the increments of the vegetative part from the middle toward the terminal portion, as shown by the more and more expanded condition of the lamina and decreasing sporangia, indicate that vegetative forces are again in the ascendency. This suggests how unstable is the poise between the vegetative leaf and sporophyll in structure and function in the case of this species.

For two successive years I have endeavored by experiment to produce this transformation in *Osmunda cinnamomea*, but thus far without sufficiently marked results. The stem of the plant is stout, and this, together with the bases of the leaves closely overlapping, contains considerable amounts of stored nutriment, which make it difficult to produce the results by simply cutting off the foliage leaves. The fact that these transformations are known to occur where fire has overspread the ground, and, as I have observed, where the logging in the woods seriously injured the stools of the plant, it would seem that deeper seated injuries than the mere removal of foliage leaves would be required to produce the transformation in this species. It may be that such injury as results from fire or the severe crushing of the stools of the plant would be sufficient to disturb the equilibrium which existed at the time, that the action of the correlative forces is changed thereby, and there would be a tendency for the partially developed foliage leaves to form sporangia, then when growth has proceeded for a time this balance is again changed.

The theory that the foliage leaves of the

sporophyte have been derived by a process of sterilization, and that the transformation of sporophylls to foliage leaves in an individual indicates the mode of progress in this sterilization, does not necessarily involve the idea that the sporophyll of any of the ferns, as they now exist, was the primary form of the leaf in that species, and that by sterilization of some of the sporophylls, the present dimorphic form of the leaves was brought about. The process of the evolution of the leaf has probably been a gradual one and extends back to some ancestral form now totally unknown. One might differ from Professor Bower in the examples selected by him to illustrate the course of progress from a simple and slightly differentiated sporophyte to that exhibited in the various groups of the Pteridophyta, but it seems to me that he is right in so far as his contention for the evolution of vegetative and assimilatory members of the sporophyte can be illustrated by a comparison of the different degrees of complexity represented by it in different groups, and that this illustrates the mode of progress, as he terms it, in the sterilization of potential sporangenous tissue.

On this point it appears that Professor Bower has been unjustly criticised. The forms selected to illustrate his theory were chosen not to represent ancestral forms, or direct phylogenetic lines, but solely for the purpose of illustrating the gradual transference of spore-bearing tissue from a central to a peripheral position, and the gradual eruption and separation of spore-bearing areas, with the final sterilization of some of these outgrowths.

To maintain that in phylogeny the sporophyll is a transformed foliage leaf would necessitate the predication of ancestral plants with only foliage leaves, and that in the case of these plants the vegetative condition of the sporophyte was the primary one, spore production being a later developed function. Of the forms below the Pteridophyta, so far as our present evidence goes, the sporophyte originated through what Bower calls the gradual elaboration of the zygote. All through the Bryophyta, wherever a sporophyte is developed, spore production constantly recurs in each cycle of the development, and yet there is no indication of any foliar organs on the sporophyte. The simplest forms of the sporophyte contain no assimilatory tissue, but in the more complex forms assimilatory tissue is developed to some extent, showing that the correlative forces which formerly were so balanced as to confine the vegetative growth to the gametophyte, and fruiting to the sporophyte, are later changing; that vegetative growth and assimilation are being transferred to the sporophyte, while the latter still retains the function of spore production, though postponed in the ontogeny of the plant.

If we cannot accept some such theory for the origin of sporophylls and foliage leaves by gradual changes in potentially sporogenous tissue somewhat on the lines indicated by Bower, it seems to me it would be necessary, as already suggested, to predicate an ancestral form for the Pteridophyta in which spore production was absent. That is, spore production, in the sporophyte of ancestral forms of the Pteridophyta, may never have existed in the early period of its evolution and spore production may have been a later development. But this, judging from the evidence which we have, is improbable, since the gametophyte alone would then be concerned in transmitting hereditary characters, unless the sporophyte through a long period developed the gametophyte stage through apospory. Bower says in taking issue with Goebel's statement that the experiments on Onoclea prove the sporophyll to be a transformed foliage leaf: "I assert, on the other hand, that this is not proved, and that a good

case could be made out for priority of the sporophyte; in which event the conclusion would need to be inverted, *the foliage leaf would be looked upon as a sterilized sporophyll.* This would be perfectly consistent with the *correlation* demonstrated by Professor Goebel's experiments, as also with the intercalation of a vegetative phase between the zygote and the production of spores." In another place he says: "To me, whether we take such simple cases as the Lycopods or the more complex case of the Filicineæ, the sporangium is not a gift showered by a bountiful Providence upon pre-existent foliage leaves; the sporangium, like other parts, must be looked upon from the point of view of descent; its production in the individual or in the race may be deferred, owing to the intercalation of a vegetative phase, as above explained; while, in certain cases at least, we probably see in the foliage leaf the result of the sterilization of sporophylls. If this be so, much may be then said in favor of the view that the appearance of sporangia upon the later formed leaves of the individual is a reversion to a more ancient type rather than a metamorphosis of a progressive order."

As I have endeavored to point out in another place, if a disturbance of these correlative processes results in the transference of sporophyllary organs to vegetative ones on the sporophyte "why should there not be a similar influence brought to bear on the sporophyte, when the same function resides solely in the gametophyte, and a disturbing element of this kind is introduced? To me there are convincing grounds for believing that this influence was a very potent, though not the only one in the early evolution of sporophytic assimilatory organs. By this I do not mean that in the Bryophyta, for example, injury to the gametophyte would now produce distinct vegetative organs on the sporophyte, which would tend to make it independent of the gametophyte. But that in the bryophyte-like ancestors of the pteridophytes an influence of this kind did actually take place, appears to me reasonable.

"In the gradual passage from an aquatic life, for which the gametophyte was better suited, to a terrestrial existence, for which it was unadapted, a disturbance of the correlative processes was introduced. This would not only assist in the sterilization of some of the sporogenous tissue, which was taking place, but there would also be a tendency to force this function on some of the sterilized portions of the sporophyte, and to expand them into organs better adapted to this office. As eruptions in the mass of sporogenous tissue took place and sporophylls were evolved, this would be accompanied by the transference of the assimilatory function of the gametophyte to some of these sporophylls."

Because sporophytic vegetation is more suited to dry land conditions than the gametophytic vegetation, it has come to be the dominating feature of land areas. Because the sporophyte in the Pteridophyta and Spermatophyta leads an independent existence from the gametophyte, it must possess assimilatory tissue of its own, and this is necessarily developed first in the ontogeny, but it does not necessarily follow, therefore, that the foliage leaf was the primary organ in the phylogeny of the sporophyte. The provision for the development of a large number of spores in the thallophytes, so that many may perish and still some remain to perpetuate the race, is laid hold on by the bryophytes where the mass of spore-bearing cells increases and becomes more stable, for purposes of the greatest importance. Instead of perishing, some of the sporogenous tissue forms protecting envelopes, then supporting and conducting tissue, and finally, in the pteridophytes and spermatophytes, nutritive and assimilatory structures are developed. Nature is prodi-

gal in the production of initial elementary structures and organs. But while making abundant provision for the life of the organism through the favored few, she has learned to turn an increasing number of the unfavored ones to good account. Acted upon by external agents and by internal forces, and a changing environment, advance is made step by step to higher, more stable and prolonged periods.

While we have not yet solved any one of these problems, the results of experimental morphology are sufficient to indicate the great importance of the subject and the need of fuller data from a much larger number of plants. If thus far the results of experiments have not been in all cases sufficient to overthrow the previous notions entertained touching the subjects involved, they at least show that there are good grounds for new thoughts and new interpretations, or for the amendment of the existing theories. While there is not time for detailing, even briefly, another line of experiment, viz, that upon leaf arrangement, I might simply call attention to the importance of the experiments conducted by Schumann and Weisse from the standpoint of Schwendener's mechanical theory of leaf arrangement ('78). Weisse ('94) shows that the validity of the so-called theory of the spiral arrangement of the leaves on the axis may be questioned, and that there are good grounds for the opening of the discussion again. It seems to me, therefore, that the final judgment upon either side of all these questions cannot now be given. It is for the purpose of bringing fresh to the minds of the working botanists the importance of the experimental method in dealing with these problems of nature that this discussion is presented as a short contribution to the subject of experimental morphology of plants.

Geo. F. Atkinson.

Cornell University.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

During the Toronto meeting of the British Association for the Advancement of Science the Section in Physiology held seven sessions under the presidency of Professor Michael Foster (Cambridge). The sessions were held in the Biological Building of the University of Toronto, and forty-one papers and demonstrations were presented. The proceedings began upon Thursday, August 19th, with the admirable address of the President, which will be printed in a future number of Science. The sectional papers of that day related in general to the subject of motion. Professor H. P. Bowditch (Harvard) discussed the rhythm of smooth muscles. Rings from the frog's stomach, when suspended, exhibit sooner or later spontaneous contractions, which continue for from forty-five minutes to twenty-four hours. The graphic curve of such contractions seems to be compound, being formed by the superposition of two waves, which represent two rhythmic contractions of different rates. Sets of contractions are also repeated rhythmically. Professor G. C. Huber (Michigan) gave the results of further researches on the innervation of motor tissues with especial reference to nerve-endings in the sensory muscle-spindles. The main points in this paper are given in Science, Vol. V., p. 908. Mr. O. F. F. Grünbaum (Cambridge) demonstrated by lantern slides the muscle-spindles in pathological conditions. Professor F. S. Lee (Columbia) discussed the ear and the lateral line in fishes. These two organs are equilibrative in function, and the former is probably the phylogenetic derivative of the latter. Audition in the customary sense of the word is wanting in fishes, and first appears with the change from an aquatic to a land existence. Professor W. P. Lombard (Michigan) spoke on the effect of the frequency of excitations on the contractility of muscles. Dr. J. H.

Kellogg reported the results of a dynamometric study of the strength of the several groups of muscles and the relation of the corresponding homologous groups of muscles in man.

The session of Friday morning, August 20th, was devoted mainly to the presentation of papers on the circulation. Professor G. N. Stewart (Western Reserve) gave a large number of measurements of the output of the mammalian heart examined by a new method. Professor W. T. Porter (Harvard) reported his observations on the mammalian heart concerning the cause of the heart-beat, fibrillary contractions, the influence of ventricular systole on the blood-flow through the heart-muscle, and the circulation through the veins of Thebesius. (See SCIENCE, p. 905, 906.) Professor Karl Hürthle (Breslau) discussed the resistance of the vascular channels. Resistance depends on two factors—the internal friction of the blood and the dimensions of the tubular system. Measurements of the former by the author's method give the result: internal friction of distilled water at 37°C.: that of blood : : 1 : 4.5 (dog), 4.1 (cat), 3.2 (rabbit). From this and certain other data, the author calculates the resistance expressed in terms of the dimensions of a tube through which, under the given conditions, the same quantity of blood could flow. The resistance through the several organs and over the entire vascular course is now being measured. Dr. W. H. Gaskell (Cambridge) gave a comparative résumé of the physiology of the cardiac branches of the vagus nerve in the five main divisions of the vertebrates. Professor A. R. Cushny (Michigan) discussed rythmical variations in the strength of the contractions of the mammalian heart. Professor W. H. Thompson (Belfast) presented a report upon the physiological effects of peptone and its precursors when introduced into the circulation. The research is in the hands of a committee consisting of Professors Schäfer, Sherrington, Boyce and Thompson, and the work of the past year has been carried on by Professor Thompson. The effects of Witte's peptone, pure peptone, anti-peptone and deutero-albumose were given in detail. Professor E. W. Reid (Dundee) presented the results of experiments on the absorption of serum in the intestine. Water and organic and inorganic solids are absorbed against an excess of hydrostatic pressure in the blood-vessels. The results seem to exclude explanation by osmosis, filtration into capillaries or lacteals, imbibition, electro-osmotic action, and aspiration by the blood-current.

In the afternoon of Friday Professor Anderson Stuart (Sidney) spoke upon a newly discovered function of the canal of Stilling in the vitreous humor in receiving lymph during the accommodation of the eye. Professor Stuart also described a number of simple pieces of physiological apparatus which he had found useful for demonstrative purposes. Dr. Noel Paton (Edinburgh) discussed the phosphorus metabolism of the salmon in fresh water, with especial reference to the diminution of phosphorus in the muscle and its increase in the reproductive organs. The loss of phosphorus from the muscle is barely sufficient to account for the gain in the ovary, and amply sufficient for the gain in the testis. But the phosphorus compounds—chiefly lecithin and ichthulin in the ovary and nuclein in the testis—must be formed synthetically. Lecithin is probably one of the first stages in the construction of nucleo-compounds. Professor J. Loeb (Chicago) demonstrated and discussed certain electrostatical stimulative effects upon nerves, which might be mistaken for electro-magnetic effects. Professor G. Lusk (Yale) gave the results of experiments on the gastric inversion of cane sugar by hydrochloric acid, which show that the acidity of the

gastric juice is sufficient to produce such inversion as takes place in the stomach.

The section held no session on Saturday, the majority of the members making the excursion to Niagara.

Monday forenoon was devoted to the subject of neurology. Professor Carl Huber (Michigan) gave an account of his study of the comparative histology of the cells of the sympathetic nervous system. (See SCIENCE, Vol. V., p. 132.) Dr. J. J. Mackenzie (Toronto) spoke on the microchemistry of nerve-cells. Mr. W. B. Warrington gave the details of an investigation of the changes in nerve-cells in various pathological conditions, the latter being caused by various organic poisons, anæmia, the division of peripheral nerves, and the division of the posterior roots. Professer A. Waller (London), who is a member of the committee previously appointed by the Association to investigate the changes which are associated with the functional activity of nerve-cells and their peripheral extensions, and who has been working upon the electro-physiology of isolated nerve, made an elaborate and valuable roport upon the action of acids, alkalies, carbonic acid, tetanization and temperature upon electrotonic currents in nerve. Such currents are physiological, as well as physical. Normally the anodic current (A) is greater than the kathodic (K), in the proportion of 4 or 5 to 1. Rise of temperature to 40° causes diminution of A and increase of K. K is favored by acidification and tetanization, disfavored by basification; alterations of A are less uniform and characteristic. Tetanization and CO_2 have similar effects upon the electrotonic currents. In Dr. Waller's opinion this proves that the tetanization of an isolated nerve gives rise to a production of CO_2. In view of the impossibility heretofore of obtaining any evidence whatever of metabolism in an acting nerve, this conclusion is most important and suggestive, as bearing upon the nature of the nerve impulse. During the presentation of Dr. Waller's paper Miss Welby demonstrated the method used in his laboratory of applying anæsthetics to isolated tissues, employing for the purpose cardiac muscle. Professor Charles Richet (Paris) announced his discovery of a refractory period in the cerebral and medullary nervous centers of the dog. If these be rhythmically stimulated they will respond to either every stimulus or only every other one, according to the temperature and rate of excitation. The duration of the period is 0.1″ at 30° C. Man has a refractory period, since he cannot think at a greater frequency than 10 to 12 per second. Hence the psychological unit of time, or the elementary period of consciousness, is about 0.1″, which, therefore, represents the duration of vibration of the nerve-center.

Monday afternoon was given up to demonstrations. Professor W. P. Lombard (Michigan) showed a cheap and simple chronograph. Professor C. S. Sherrington (Liverpool) demonstrated various new facts regarding visual contrast and flicker. Professor A. B. Macallum (Toronto) showed microscopic specimens illustrating the distribution of iron in cells, and Professors W. A. Herdman and R. Boyce (Liverpool) microscopic specimens illustrating the presence of copper in cells.

On Tuesday morning the Sections in Physiology and Botany held a combined meeting to discuss the chemistry and structure of the cell. This attracted a considerable audience and was one of the most interesting of the sessions. The discussion was opened by Professor R. Meldola (London), who spoke on the rationale of chemical synthesis. Comments were made by Professors J. R. Green (Cambridge), W. D. Halliburton (London), I. Remsen (Johns Hopkins), H. Marshall Ward (Cambridge), and H. E. Armstrong (London). Professor J. R. Green (Cambridge) presented experi-

mental evidence of the existence in yeast of an alcohol-producing enzyme. Professor A. B. Macallum (Toronto) presented certain new views on the significance of intracellular structures and organs. According to him the centrosphere is the oldest part of the cell. The nucleus and the cytoplasm are secondary structures. This explains the fact that in cell-division the division of the centrosome precedes that of the rest of the cell. These views were opposed by Mr. H. Wager (Leeds), who gave strong evidence for the presence of a nucleus in the yeast-cell, and by Professor J. B. Farmer (London).

The final session was held on Wednesday forenoon and was devoted to psychological and miscellaneous papers. Professor W. D. Halliburton (London), on behalf of himself and Dr. Mott, discussed the action of cholin, neurin and allied substances on the circulation, in connection with the discovery by them, in the cerebro-spinal fluid in certain forms of insanity, of a substance which appears identical with cholin and depresses blood-pressure by acting upon the heart. Professor R. Boyce (Liverpool), on behalf of himself and Professor W. A. Herdman (Liverpool), discussed the presence of copper in animal cells. Papers were read by Dr. T. W. G. McKay on intestinal absorption of hæmoglobin and ferratin, by Mr. R. R. Bensley (Toronto) on the morphology and physiology of gastric cells, and by Mr. O. F. F. Grünbaum (Cambridge) on visual reaction to intermittent stimulation. Professor Wesley Mills (McGill) discussed the functional development of the cerebral cortex in different groups of animals (see SCIENCE, Vol. V., p. 134), and the psychic development of young animals. In the latter paper he presented the results of a correlation of the psychic development of the dog, cat, rabbit, guinea-pig, rat, and bird with the development of the cortical centers. Professor C. Lloyd Morgan (Bristol) read a suggestive paper on the physiology of instinct. The essential part of the objective aspect of instinctive activity is the coordination of outgoing impulses. This activity is at first unconscious, but later, by the coming in of afferent impulses, consciousness may appear. Professor L. Witmer (Pennsylvania) discussed the nature and physical basis of pain. Pain is a sensation, the central organ of which consists of the sensori-motor centers; no special pain nerves exist.

On account of the full program comparatively little general discussion of the papers was possible, and this constituted the one drawback of the meeting. The sectional committee, the membership of which has already been printed in SCIENCE, p. 335, held daily sessions, and the usual grants for research were asked for.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

THE PATAGONIAN EXPEDITION FROM PRINCETON UNIVERSITY.

THIS expedition, dispatched to Patagonia from Princeton University in February, 1896, returned during August. It was under the auspices of Professor W. B. Scott, of the Department of Geology, and had for its object the collecting of vertebrate fossils from the Tertiary deposits, and the skins and skeletons of recent birds and mammals. It was directly in charge of Mr. J. B. Hatcher and his assistant, Mr. O. A. Peterson.

The objective point was the Port of Gallegos, on the east coast of southern Patagonia, which was reached April 29, 1896. From this point investigations were conducted, first along the coast from Sandy Point, in the Straits of Magellan, to Port Desire, on the north. In this region many interesting fossil forms were secured and a nearly complete series of living birds, mammals and plants. After spending several

months in the coast region, an expedition was made into the interior, into the little known lake region about the head waters of the Santa Cruz river and to the northward into an absolutely unknown region of the Cordilleros. Here many new glaciers were discovered and important water courses located.

The time spent in this region was most enjoyable, and the results there attained contributed even more to the success of the trip than those nearer the coast. Being an unexplored country not only were new facts relating to the geography of the region discovered, but many animals and plants new to science were also collected; and the series of observations made, and facts obtained, relating to the age of the Cordilleros and other geological phenomena of the entire region, are of the greatest value. Scattering over the plains region of the interior were found numerous volcanic cones hitherto unreported which were shown to have been the source of the great lava beds which in many places are spread in great sheets over the surface of the country.

On account of the difficult travelling and the length of time consumed on this trip into the interior, it was absolutely impossible to take any great supply of provisions, so that it became necessary to limit the personnel of the expedition to Messrs. Hatcher and Peterson, who were gone five months on this trip, during which time not only was it impossible for them to receive or dispatch any mail, but they never met with or saw a single human being but their two selves.

The result of the work done in Patagonia may be briefly summarized as follows:

The discovery of many new facts relating to the geography of the region.

The discovery of several geological horizons new to Patagonia.

The making of a complete geological section from the igneous rocks forming the mass of the Cordilleros to the uppermost Tertiary rocks, and extending from the Cordilleros to the Atlantic coast.

The collecting of a nearly complete series of the mosses, hepatical and flowering plants, not including grasses; of some 800 skins and skeletons of recent birds and animals and about eight tons of fossils, including more than 1,000 skulls and many nearly complete skeletons—altogether, the most valuable collection from that region to be found anywhere in the world.

After spending a little more than a year on the mainland, the expedition proceeded to Tierra del Fuego and the adjoining islands, where important collections were also made, especially of the plants of that archipelago, and observations were made concerning the geology and paleontology of the islands, which it is believed will be of considerable importance. Some attention was also given to the Indians of this region, especially of the Channel and Canoe Indians, who live almost entirely in frail boats of their own manufacture and subsist wholly upon shell fish, which they are able to pick up in great abundance along the shore. The great accumulation of shell heaps observed at certain points along the shores is believed to point to a great antiquity for this exceedingly primitive tribe.

Throughout their work the Argentine government was very generous and courteous to the expedition, giving to its members transportation on its war vessels from Buenos Aires to Gallegos and return, and offering to place at its disposal a smaller vessel for use in researches among the islands.

SCIENTIFIC NOTES AND NEWS.

GRANTS FROM THE BRITISH ASSOCIATION FOR SCIENTIFIC RESEARCH.

As we have already noted, the British Association appropriated at the Toronto meeting £1,350 (more than $6,500) to committees for

scientific work. The sum was larger than usual, as the the large attendance at the Liverpool meeting left a surplus, and it was wished to favor this year the inauguration or continuation of special work in Canada. It is with reluctance that we state for comparison that last year the American Association appropriated $200 and this year $100 for scientific work. It should be remembered that such appropriations not only contribute greatly to the advancement of science, but also add much to the interest of the meetings at which the reports of the committees are presented.

The responsible member of the committee, the subject of the work and the amount in pounds each of the appropriations is as follows:

	£
Mathematics and Physics.—Professor Carey Foster: Electrical Standards	75 0 0
Mr. G. J. Symons: Seismological Observations	75 0 0
Dr. E. Atkinson: Abstracts of Physical Papers	100 0 0
Rev. R. Harley: Calculation of Certain Integrals	20 0 0
Mr. W. N. Shaw: Electrolysis and Electro-chemistry	35 0 0
Professor H. L. Callendar: Meteorological Observatory at Montreal	50 0 0
Chemistry.—Sir H. E. Roscoe: Wave-length Tables of the Spectra of the Elements	20 0 0
Professor J. Emerson Reynolds: Electrolysis Quantitative Analysis	12 0 0
Dr. T. E. Thorpe: Action upon Light Dyed Colours	8 0 0
Sir J. Evans: Promotion of Agriculture	5 0 0
Geology.—Professor E. Hull: Erratic Blocks	5 0 0
Professor T. G. Bonney: Investigation of a Coral Reef	40 0 0
Sir W. H. Flower: Fauna of Singapore Caves (unexpended balance in hand, 40*l.*)	—
Professor J. Geikie: Photographs of Geological Interest	10 0 0
Mr. J. E. Marr: Life-zones in British Carboniferous Rocks (unexpended balance in hand)	—
Professor W. Boyd Dawkins: Remains of the Irish Elk in the Isle of Man (unexpended balance in hand)	—
Mr. T. F. Jamieson: Age of Rocks near Moreseat	10 0 0
Sir J. W. Dawson: Pleistocene Fauna and Flora in Canada	20 0 0
Zoology.—Professor W. A. Herdman: Table at the Zoological Station, Naples	100 0 0
Mr. G. C. Bourne: Table at the Biological Laboratory, Plymouth	20 0 0
Sir W. H. Flower: Index Generum et Specierum Animalium	100 0 0
Professor L. C. Miall: Biology of the Lakes of Ontario	75 0 0
Professor W. A. Herdman: Healthy and Unhealthy Oysters	30 0 0
Geography.—Mr. E. G. Ravenstein: Climatology of Tropical Africa	10 0 0
Economic Science and Statistics.—Professor H. Sidgwick: State Monopolies in other Countries	15 0 0
Mr. L. L. Price: Future Dealings in Raw Produce	10 0 0
Mechanical Science.—Mr. W. H. Preece: Small Screw Gauge	20 0 0
Anthropology.—Professor E. B. Tylor: Northwestern Tribes of Canada	75 0 0
Dr. R. Munro: Lake Village at Glastonbury	37 10 0
Mr. E. W. Brabrook: Ethnographical Survey (and unexpended balance in hand)	25 0 0
Mr. A. J. Evans: Silchester Excavation	7 10 0
Dr. G. M. Dawson: Ethnological Survey of Canada	75 0 0
Sir W. Turner: Anthropology and Natural History of Torres Strait	125 0 0
Physiology.—Dr. W. H. Gaskell: Investigation of Changes associated with the Functional Activity of Nerve Cells and their Peripheral Extensions	100 0 0
Botany.—Professor J. B. Farmer: Fertilization in Phæophyceæ	15 0 0
Corresponding Societies.—Professor R. Meldola: Preparation of Report	25 0 0

THE NEW YORK BOTANICAL GARDEN.

THE New York City Board of Estimate and Apportionment gave a public hearing on September 29th in the matter of the appropriation for the Bontanical Museum for the Botanical Garden in Bronx Park. Some persons have been objecting to the plans approved by the Park Board, but in the public hearing they only took exception in a general way to the use of a portion of a Park for a Botanical Garden. The Board of Estimate and Appropriation unanimously passed a resolution granting the appropriation, after listening to a statement from the trustees, which was as follows:

"The establishment of a Botanical Garden in the city of New York has been actively prosecuted since the year 1889, the necessary legislation having been obtained in an act passed in 1891 and amended in 1894 and 1896. The project through all this period received most cordial support from the city officials and from the public. The present Board of Managers was organized on March 21, 1895, and on June 18, 1895, the condition of the act of incorporation requiring the subscription of $250,000 was fully met. At a meeting of the managers, held on that date, a special committee of five members was appointed a committee on plans, and this committee has been since continued. The securing of the necessary $250,500 as a subscription fund was reported to the Commissioners of Parks, as authorized and directed by the act of incorporation, and the selection of site was duly accepted by the Board of Managers. On October 30, 1895, the present Board of Estimate and Apportionment authorized the issue of bonds to an amount not exceeding $25,000 for surveys, plans, etc.; but these have not been issued. Prior to the organization of the Board of Managers, many of the members of the corporation had given continuous study to the project since its inception. Several of them have made critical studies of botanical gardens in the Old World.

"The committee on plans, appointed in June, 1895, studied the subject in all its aspects for a year, with the aid of advice and suggestion from many botanists, landscape gardeners, architects, and others interested, in this country and in Europe, and determined the principal ends desirable to be reached, and the most economic, artistic and practical methods of reaching them, having always in mind the beautiful features of the grounds and the great value of these to the institution; their preservation has been determined on from the very first. On June 17, 1896, the preparation of a general plan to embody the results reached after this long and careful consideration was referred to a commission of experts, consisting of N. L. Britton, director-in-chief; R. W. Gibson, architect; John R. Brinley, civil and landscape engineer; Lucien M. Underwood, professor of botany, Columbia University; Samuel Henshaw, landscape gardener; Lincoln Pierson, secretary Lord & Burnham Company, greenhouse architects. All these are men well and favorably known in their professions, and it is maintained that in this commission were included all the elements necessary or desirable for the purpose of the general study, the determination of the detailed landscape treatment and special planting being wisely deferred until the general scheme had been approved; these will be taken up under the best advice obtainable."

GENERAL.

THE Eighth International Geological Congress will meet in Paris in 1900. In 1903 the place of meeting will be Vienna.

THE New York Academy of Sciences is in great need of a building for its meetings, for its library and as a center for the scientific life of the city. A university lecture room has not been a satisfactory place of meeting, and in view of the removal of Columbia University the Academy will this year meet at the Mott Memorial Library, 64 Madison Avenue. Visitors interested in the subjects presented are welcomed at the meetings, and citizens of New York should remember that the sections meet on Monday evenings as follows: Section of Astronomy and Physics, first Monday of the month; Section of Biology, second Monday; Section of Geology and Mineralogy, third Monday; Sections of Psychology, Anthropology and Philology, fourth Monday.

OF the other societies composing the Scientific Alliance of New York the Torrey Botanical Club will meet at the College of Pharmacy, the Linnæan Society and the Entomological Society at the American Museum of Natural History, the Chemical Society at the College of the City of New York, and the Mineralogical Club and the Microscopical Society at the Mott Memorial Library.

THE New York Section of the American Chemical Society will hold its annual meeting on October 15th. Officers for the ensuing year will be elected and the retiring President, Dr. Wm. McMurtrie, will make an address on 'Some Records of Recent Progress in Industrial Chemistry.' A special meeting of the Society was held on the evening of October 1st, in honor of Professor Henry E. Armstrong, of London, who came to this country to take part in the meeting of the British Association. An address was made by Dr. H. Carrington Bolton.

THE first section of the Brooklyn Museum of Arts and Sciences was dedicated on October 2d. Addresses were made by the President of the Board of Trustees, Mr. A. A. Healy, and by the Director of the Institute, Professor Franklin W. Hooper, by Mayor Wurster, of Brooklyn, and by President Eliot, of Harvard University,

who spoke on 'The Functions of Education in Democratic Society.' The present building, which is already crowded by the collections of art and natural history, was informally opened at the beginning of June, and was visited during August by 12,000 persons. The building as projected will be thirty-two times as large as the present structure, erected by the city of Brooklyn as one of its last public works at a cost of $300,000. The charter of the combined cities composing New York at the beginning of next year provides for the liberal maintenance of the Brooklyn Institute, which will be one of the chief centers of art, science and culture in the great city.

IN his address at the recent meeting of the Associated Chambers of Commerce, Sir Courtney Boyle announced his intention of establishing a museum of samples in connection with the British Board of Trade. The scope and objects of the museum would be similar to those of the recently established commercial museums at Philadelphia.

THE sum of £442 has been collected in British India as a contribution to the Pasteur Memorial Fund.

THE Maharaja of Patiala has presented the Indian government with a site for the Pasteur Institute to be established at Simla.

THE American Public Health Association will hold its twenty-fifth annual meeting at Philadelphia from the 26th to the 29th of October.

A SCHOOL of ethics and social philosophy has been formed in London, with a general committee including the Master of Balliol, Mr. Leslie Stephen, Mr. R. B. Haldane, Mr. W. L. Courtney, Professor Sully and Mrs. Bryant. The aim of the new school is to approach social questions from the side of psychology and ethics. Lectures have been promised by Professor Henry Sidgwick, Mr. Sidney Webb, Mr. F. W. H. Myers, Mr. Bosanquet, Professor Lewis Campbell and others.

THE first installment of a card catalogue of the New York Public Library was put in use at the Astor Library this week. Some twenty-five assistants are working under Dr. Billings on the catalogue, and it is hoped that it will be completed in about three years.

THE prize lists of the Institution of Civil Engineers for the session of 1896-97 awards the Howard prize of 50 guineas to Mr. Hilary Bauerman, in recognition of his work on the metallurgy of iron. For original papers presented to the Institution, Telford medals, with premiums of books or instruments, are awarded to Messrs. H. A. Humphrey, for 'The Mond Gas-Producer Plant and its Application;' to Colonel Pennycuick, R.E., for 'The Diversion of the Parivar;' to Mr. E. C. Shankland, for 'Steel Skeleton Construction in Chicago;' to Mr. Dugald Drummond, for 'High Pressure in Locomotives;' and to Mr. Thomas Holgate, for 'The Enrichment of Coal Gas.' George Stephenson medals and Telford premiums are awarded to Mr. Cruttwell, for 'The Tower-bridge Superstructure,' and to Professor Unwin, for 'A new Indentation Test for Determining the Hardness of Metals;' Watt medals and Telford premiums to Messrs. Hay and Fitzmaurice for their joint paper on 'The Blackwall Tunnel.'

THE Royal Society of New South Wales offers its medal and ten guineas for the best communication (provided it be of sufficient merit) containing the result of original research or observations on the following subjects; 'On the Iron-ore deposits of New South Wales' (time limit, May 1, 1898); 'On the Life History of the Australian Teredo and other specimens of Australasian wood-eating Marine Invertebrata, and on the means of protecting timber from their attacks' (time limit, May 1, 1899). The competition is not confined to members of the Society, nor to residents in Australia. The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labor, but it is hoped that the honor will be regarded as a sufficient inducement and reward.

THE United States Civil Service Commission announces that on October 25, 1897, it will hold examinations to establish a register from which selections may be made to fill numerous minor vacancies in special and technical positions in the government service. A list of the examinations which will be held, and of the cities at which they may be taken, will be furnished on request.

SECRETARY WILSON, of the Agricultural Department, will, in his annual report, ask Congress to make an increase in the appropriation for the Bureau of Animal Industry, the Farmers' Bulletins and the Weather Bureau.

PROFESSOR WIESNER, of Vienna, has undertaken during the past summer, says *Nature*, a journey to Spitsbergen to complete his observations, previously made in the Tropics, as to the effect of light and other external conditions on the growth of plants.

THE members of the Stanford University party who have been engaged in branding seals by electricity on Pribyloff Islands have, as we learn from the daily press, arrived at Palo Alto. They claim that the experiment was successful. Besides the work of taking the seal census and building a fence enclosing the salt lagoon to prevent the redriving of bachelor seals, a number of bird skins, skeletons, insects and marine invertebrates were collected. The party consisted of Messrs. Greely, '98; Snodgrass, '99; Edwards, 1900; Bristow and Adams, 1900, and Instructor Farmer.

WE learn from the London *Times* that Miss Ormerod, of Torrington-house, St. Albans, continues to supply the leaflet on the common sparrow, and that several of the largest British landowners are interesting themselves in the endeavor to reduce the numbers of *Passer domesticus* to within reasonable limits. Since attention was first drawn to the matter a few weeks ago Miss Ormerod has received applications for the pamphlet from most unexpected places—Stavanger, St. Petersburg and Smyrna, for example. So great is the demand that yet another edition of 5,000 copies has been printed. Miss Ormerod sends the pamphlet free on a receipt of a stamp for postage and many copies should find their way to America.

A DESPATCH to the daily papers from Bombay states that the latest health statistics show that the bubonic plague is again active, having crept unobserved from hamlet to hamlet until a wide area is affected. The newspapers assert that the withdrawal of the medical officers for service with the troops on the frontier will entail consequences more disastrous than anything happening on the frontier.

As we learn from *Nature*, the Commission du Musée d'Histoire Naturelle at Geneva has formed itself into a committee having for its object the erection of a monument to the memory of François Jules Pictet de la Rive. A site for the monument has been granted in front of the museum. Old students of the eminent investigator, and all who are interested in the work which he accomplished, are invited to send subscriptions for the memorial fund to MM. Lombard, Odier et Cie, Genève.

THE Icelandic Parliament has voted a subsidy for the laying of a cable from Scotland to Iceland by way of Faroe Islands. The Great Northern Telegraph Company will lay the cable during the early summer next year.

A REFUGEE hut on the Zugspite, the highest mountain in Germany (10,000 feet), near Garmisch, in the center of the Bavarian Highlands, has been opened. It stands on the Grat between the east and west peaks, affords accommodations for twenty-two guests, and has been erected at a cost of $10,000.

WITH the beginning of the next volume in January *The American Naturalist* will be published by Ginn & Co., Boston, New York and Chicago.

THE government of India and Lord George Hamilton have offered hearty congratulations to Sir Joseph Hooker on the occasion of the completion of the 'Flora of British India,' on which he has been engaged for twenty-five years. Sir Joseph will now undertake to complete the 'Flora of Ceylon,' left unfinished by the death of Dr. Trimen.

WE have received from John P. Morton & Son, Louisville, a guide to the Mammoth Cave, of Kentucky, by Horace C. Hovey and R. Ellsworth Call. Both of the authors have for years been familiar with the Mammoth Cave and have published works on American caverns. It is a great advantage to have a guide book by men of science, written with accuracy and without exaggeration. Visitors to the cave using this book will learn much of its geology and natural history, and it will also prove useful to those who are studying the scientific problems involved.

THE three leading articles of the October *Monist* deal with questions of evolution. The

first is a posthumous essay by the late George J. Romanes on 'Isolation as a Factor of Organic Evolution,' wherein Mr. Romanes discusses the contributions of Mr. Gulick to the theory of development, and gives it as his opinion that isolation is to be ranked with heredity and variability as 'the third pillar of a tripod on which is reared the whole superstructure of organic evolution.' He contends that even the principle of natural selection lies less deep, and makes of the latter a special case of isolation. Mr. Romanes also discusses his own doctrine of physiological selection. The second article, by Professor Eimer, of Tübingen, on 'The Origin of Species,' gives a concise digest of his views of evolution and exemplifies them by material and illustrations from his new forthcoming researches on butterflies. Eimer explains the origin of species, (1) by cessation of development at definite stages, (2) by evolution *per saltum*, and (3) by prevention of impregnation, which is similar to Romanes's physiological selection. He accords to natural selection a subordinate rôle only, having efficacy in the preservation but not in the origination of species. The transmutation of forms is controlled by orthogenesis, or definite development, and not by chance variation. The article is substantially Professor Eimer's Leyden address, which has not yet appeared in German. The third article is by Dr. Paul Topinard, and constitutes part of his series 'Man As a Member of Society,' in which the French anthropologist traces the influence of the factors which have affected social development from the beginning of civilization to its highest consummation.

THE following field meetings have been arranged by the Torrey Botanical Club, of New York:

Oct. 2d.—Mosholu, N. Y., N. Y. & P. R. R. Leave 155th St. (Ninth and Sixth Ave. Terminal, Manhattan Elevated R. R.) at 9:30 a. m. Returning, leave Mosholu at 12:37 p. m., or as desired. Object: Asters and Goldenrods. Excursion fare, 30 cts. Guide, Professor Burgess.

Oct. 9th.—Woodhaven, Long Island, L. I. R. R. Leave foot E. 34th St. at 1:30 p. m. Returning, leave Woodhaven as desired. Excursion fare, 35 cts. Guide, Mr. Hulst.

Oct. 16th.—Caryl, N. Y., N. Y. & P. R. R. Leave 155th St. at 1:00 p. m. Returning, leave Caryl at 5:17 or 5:47. Excursion fare, 30 cts. Guide, Mr. Constantine.

Oct. 23d.—Tarrytown and Sleepy Hollow, N. Y., N. Y. C. & H. R. R. R. Leave Grand Central Station at 1:00 p. m. Returning, leave Tarrytown at 5:37 p. m. Excursion fare, $1.00 Guide, Dr. Barnhart.

Oct. 30th.—Fort Lee, N. Y. Leave foot of 125th St. at 1:00 p. m. Returning as desired. Fare, 10 cts. Guide, Mr. Clute.

THE Committee of Fifty has requested Professor C. F. Hodge, Clark University, to gather the testimony of physiologists upon two topics relating to the practical teaching of the physiology of alcohol, and he is asking the following questions: *First*, as to the facts at our disposal, will you please give a list of the points which you consider sufficiently well established and of essential importance to the education of medical and university students? We wish to learn your own view of the physiology value of alcohol as a food, condiment, stimulant and medicine; its influence upon the tissues, organs and upon physiological processes. Please give also a list of the important points that you think are not sufficiently well proved to form a part of our teaching material, the points about which there is too much present difference of opinion. *Second*, to what extent do you think it wise to introduce alchohol physiology into elementary public school courses? I refer to the 'Scientific Temperance Instruction' promoted by the W. C. T. U., viz.: the requirement by law that the subject be given considererable prominence throughout the school course. Have you examined any of the 'approved and endorsed' physiologies? If so, which ones? What is your opinion of them? Finally, will you give a list of the arguments which seem most conclusive to yourself either for or against this method of preventing alcoholism?

MR. JOSEPH COLLINSON, writing to the London *Times*, from Walsingham, Durham county, after referring to the reports showing that three golden eagles have been killed in Great Britain within the last six months, and two last year, says: "Our country is being rapidly deprived of some of the noblest of its feathered inhabit-

ants. During the last few years a number of species have become extinct, and other species are fast disappearing. Most of us, unfortunately, have never had the pleasure of seeing many of these birds, and I agree with Hudson as to the cause—the direct action of man, the greedy collector mainly, whose methods are as discreditable as his action is injurious. No one wishes to preserve birds which are really harmful, if such there be; but all birds which are merely curious and rare should be strictly preserved by the legislature. There must be a remedy for this state of things. In pointing out that the Wild Birds Protection Acts should be made general in terms, I beg to suggest that, if all birds cannot be protected, the right principle is to enumerate just those species which are to be outside the pale of protection, not those which are to be within it."

In Argentina, Cyprus and many other countries the locust is a formidable crop pest. A successful series of experiments carried out in Natal, a report of which has been published in that colony as a government notice, and is abstracted in the London *Times*, will prove of interest in many parts of the world. All attempts to suppress the locust scourge in Natal have proved only partially successful, with the exception of the plan of poisoning with arsenic, which, it is asserted, has met with absolute and unqualified success. The mixture used is prepared by heating four gallons of water to boiling point and then adding 1 pound of caustic soda. As soon as this is dissolved, 1 pound of arsenic is added, after which the liquid is well stirred and boiled for a few minutes, care being taken that the fumes are not inhaled. Being poisonous the mixture is kept under lock and key, but when required for use half a gallon of it is added to four gallons of hot or cold water, with brown sugar or treacle. Maize stalks, grass, etc., dipped in the mixture are placed along the roads and in the fields, and the material can also be splashed with a whitewash brush upon anything which the locusts are known to have a liking for. Attracted by the odor of the sugar or treacle over a distance of as much as 100 yards, the locusts will eat of the mixture and die. Arsenic is quite effective in destroying flying locusts, but as they come and go very suddenly, it is difficult to have the poison in readiness at the critical moment, and hence the most deadly blow can be dealt at the pest when it is in the hopper stage.

A message to all interested in promoting the education of the deaf in Europe has been sent from the officers and directors of the Columbia Institution for the Deaf and Dumb, at Washington, signed by William McKinley, Edward M. Gallaudet and others. In the opening paragraphs it is stated that the oldest school for the deaf in the United States was established in 1817, eighty years ago. In 1857 there were nineteen schools, the buildings and grounds of which had cost $1,371,736, the annual support of which involved an expenditure of $285,416, and in which 1,771 pupils were being educated. At the present time there are eighty-nine schools, with 11,054 pupils under instruction during 1896. Thirty-four of these schools are in private hands, or are day-schools connected with the common-school system of some city or town. No statistics are available as to the cost of buildings and current expenses of these. For the fifty-five public institutions more than $11,-000,000 have been expended on buildings and grounds, and nearly $2,000,000 are appropriated, annually, for current expenses. In every State of the Union public provision is made for the education of the deaf, thirty-nine States having schools of their own, and the six States without them providing for the education of their deaf children in the schools of the neighboring States.

It is safe to predict that the forests of Alaska will be of greater value to the world than its gold. *Garden and Forest* devotes the leading article of the last issue to the subject, saying: "Trees cannot be cut lawfully in Alaska for timber or fuel, for there is no law which permits the sale of stumpage or timber-lands, and no law relating in any way to the forests but the one which forbids all shipment of wood from the Territory. There are a few sawmills in Alaska, however, and the number will soon be increased, and a large quantity of firewood is consumed at the salmon canneries and quartz mines, but the government gets nothing for it, and is powerless to prevent damage to the

public domain. Fortunately, the climate of southeastern Alaska is so humid that forest fires are rare and never very destructive, and reproduction is sure and rapid. These forests, therefore, even with American methods, will not soon or easily be destroyed; and here and to the southward, along the coast ranges and islands of British Columbia, through nine degrees of latitude from Cross Sound, at the north of Chicago Island, to the Straits of Fuca, is now the greatest continuous body of coniverous timber in the world, almost unmarked as yet by the axe, safe from fire and of easy access, from which the world will be able to draw great stores of material when the Redwoods and Douglas Spruces of the South have fallen, and the south-Atlantic and Gulf-shore pineries are only dim memories."

UNIVERSITY AND EDUCATIONAL NEWS.

The attendance at the American colleges and universities will be larger this year than ever before. The numbers given at present are subject to revision, but nearly all institutions report the largest entrance classes ever recorded. At Harvard the Freshman class will be over 500. At Yale the academic Freshmen number about 350 (a slight decrease as compared with last year), and the Freshmen in the scientific department about 175. At Pennsylvania nearly 200 Freshmen were registered, about 35 more than last year. The entrance class at Princeton will number over 300.

The colleges for women—Bryn Mawr, Vassar, Wellesley, Smith and others—also report an increased attendance. It is noteworthy that there are in the United States 139 colleges and universities exclusively for men and 162 exclusively for women.

It is now stated that the estate of the late Henry M. Pierce will yield $750,000 to each of the five legatees, which include Harvard University and Massachusetts Institute of Technology.

By the will of the late Dr. Antoine Ruppaner the Harvard Medical School will receive $10,000, to be called the Dr. Ruppaner Fund.

Mr. H. H. Hunnewell has given $5,000 towards the endowment of the Surgical Laboratory of the Harvard Medical School.

The Rev. Dr. Eliphalet Nott Potter, formerly President of Union College and of Hobart College, has accepted the presidency of the Cosmopolitan 'University' (Correspondence School).

Dr. Hans Reusch, director of the geological survey of Norway, has been appointed for 1897–98 to the Sturgis-Hooper professorship of geology in Harvard University, left vacant since the death of Professor J. D. Whitney a year ago. Dr. Reusch will lecture on Vulcanism during the first half year, treating volcanoes and eruptive rocks in general; earthquakes and movements of the earth's crust. In the second half year he will lecture on the Geology of Northern Europe, and its relations to general geology. The third hour of each week will be set apart for seminary work. In the spring Professor Reusch proposes to take part in the instruction of advanced students in the field.

In addition to a number of assistants, the following instructors have been appointed at the Massachusetts Institute of Technology: Carl H. Clark, S.B., in mechanical engineering; Frederick A. Hannah, S.B., in mechanical engineering; Charles M. Spofford, S.B., in civil engineering. The following promotions have also been made: Arthur A. Noyes, S.B., Ph.D., associate professor of organic chemistry; Frank A. Laws, S.B., assistant professor of electrical measurements; Harry M. Goodwin, S.B., Ph.D., assistant professor of physics.

DISCUSSION AND CORRESPONDENCE.

RESULTS FROM THE HIGHEST KITE FLIGHT.

To the Editor of Science: Aided by a grant from the Hodgkins Fund of the Smithsonian Institution, the Blue Hill Observatory is endeavoring to obtain meteorological records in the free air at heights exceeding 10,000 feet, and on September 19th such records were obtained at the highest level which kites are known by the writer to have attained.

The flight in question was conducted without mishaps by my assistants, Messrs. Clayton, Fergusson and Sweetland. On the day mentioned, the sky was clear and the wind blew from the south in gusts of from 20 to 35 miles an hour. The Richard baro-thermo-hygrograph, which weighs three pounds and was suspended 130 feet below two large kites of Mr.

Hargrave's form but of Mr. Clayton's construction, left the top of Blue Hill at noon. Similar smaller kites were attached to the main wire at intervals, so that the 20,670 feet of wire unreeled, which weighed 59 pounds, were sustained in the air by seven kites, having a total lifting surface of 213 square feet. Angular measurements at the windlass of the meteorograph enabled its height to be determined at definite times. The greatest height was reached at 4:17 p. m., when the meteorograph was 9,255 feet above Blue Hill, or 9,885 feet above the neighboring ocean. The meteorograph remained more than a mile above the sea during five hours. The reeling-in by means of the steam windlass occupied about two hours, and at 6:40 p. m. the meteorograph returned to the ground.

The automatic records were found to be smooth and distinct, with the exception of a portion of the barometer and hygrometer traces which was lost, owing, perhaps, to the temporary drying of the ink in the pens. The altitudes given by the barograph agreed closely with those computed from the angular measurements, showing that the barometric heights were nearly correct for the mean temperature encountered. The thermograph showed the lowest temperature to have been 38° at 9,255 feet above the hill, whereas on the hill at the same time the temperature was 63°, giving a mean decrease of only 1° for each 370 feet of ascent. The relative humidity varied greatly with altitude, although on the Hill it remained near 50 per cent. of saturation during the first half of the flight, increasing to about 80 per cent. at the end. Up to approximately 3,000 feet above sea-level the relative humidity increased, proving the existence of an invisible vapor stratum near the level of the cumulus cloud level. Higher it suddenly decreased, but increased to over 80 per cent. at the height of a mile, indicating the level of the alto-cumulus clouds. Above 8,000 feet the humidity was very low and probably less than 30 per cent. of saturation. The wind veered to west as the kites rose and became steadier, although its velocity was probably greater than near the hill top, since the pull on the windlass, which was counteracted in part by the weight of the suspended wire, exceeded 150 pounds when all the kites were high in the air.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY,
September 27, 1897.

'THE PRESENT EVOLUTION OF MAN.'

THE discussion of my review of his work, which is given by Mr. Archdall Reid on pp. 368–372 of your issue of September 3d, deserves some sort of reply. Yet I write with some reluctance, because I can only make such comments as must already have suggested themselves to many readers, without attempting an adequate treatment of the matters in dispute, which would require a book.

As regards Mr. Reid's theory of retrogression, I certainly have to say that I think it is wrong. The general statement 'that the ontogeny recapitulates the phylogeny' was a brilliant generalization when first made, and within reasonable limits accorded with the facts. But surely it has since been made a fetish of, and the version of it accepted in some quarters reminds one of the not uncommon popular notion that all animals are descended from one another in a direct line! According to Mr. Reid's view, I do not quite see how a female can transmit male characters, or *vice versa*, as undoubtedly occurs. If, for example, the beard is a comparatively new character, a woman, having no beard, is so far atavistic. Yet that beardless woman will have bearded male offspring, independently of the hairiness of the the father. But if such illustrations are objected to as being different from those intended by Mr. Reid, we may take the case of a seasonally dimorphic butterfly, which alternately loses and gains a set of characters. Here we have a series ABABAB, etc. If A is the oldest phase, then B reverts to A, and the opposite process should not be possible. When we contemplate the primary and secondary sexual characters and all the phenomena of dimorphism and polymorphism, I do not see how we can avoid the conclusion that germinal selection is a reality. At all events, the writer, after carefully reconsidering the matter in the light of Mr. Reid's new statement, is more than ever convinced of the validity of his former argument.

Now, as to 'social efficiency,' I am equally unconvinced of error. Is it not clear that social conditions powerfully affect the selection of individuals, and therefore a society or nation depends for its existence largely on its corporate virtue? It is a commonplace of history that the success of nations has depended largely on their laws and customs, those advancing and spreading whose social conditions favored the existence of brave and noble men. To the evolutionist, the most discouraging feature of our present day civilization is the survival of knaves and fools, while good men and true so often go to the wall. If this process is not checked, the inevitable result is the breaking-up of society and a return to some form of savagery.

Mr. Reid's argument about alcohol appears to depend largely on his theory of retrogression —a theory which I do not accept. Of course, I do not deny that the general use of alcohol will lead to a process of evolution against it, but I do deny the desirability of any race undergoing such a process. The practices of the Spartans led to the survival of the strongest among their children, while weaklings perished; and while we should not now imitate them, they were justified in so far as the survivors were best fitted to defend the community in a time when physical defense was of prime importance and incapables were a serious hindrance. But the survivors of the pot-house are not particularly valuable individuals in other respects, nor is the ability to remain unaffected in the presence of whiskey a guarantee of good citizenship. Those very nations which are said by Mr. Reid to drink heavily are the leading nations of the world to-day. If Greece was anciently drunken and now is temperate, by all means give us drunken Greece!

There are three kinds of people, thus:

1. Those who have strong desires and keep them within bounds or divert them into suitable channels for social reasons.

2. Those who have strong desires but do not keep them within bounds or divert them into suitable channels.

3. Those who have not strong desires.

Mr. Reid's alcoholic evolution would apparently give us the third class. Savages largely belong to the second. I maintain that both the second and third classes are wholly undesirable, and that the first is the one to make a successful nation and to prove itself the fittest in the struggle for existence.* The second may become the first more easily than the third, and hence is more desirable. As missionaries will say, give us a man who strongly believes something, however demoniacal, and we can do something with him; but give us a man with no beliefs and we are almost helpless.

I fear Mr. Reid will feel strongly the inadequacy of my reply to his criticism, but he will forgive me in view of the difficulty of expressing oneself on such subjects in a few words. One's opinions are founded on the sum-total of one's knowledge and experience, and cannot always find justification in a few paragraphs.

T. D. A. COCKERELL.

MESILLA, NEW MEXICO,
September 9, 1897.

* The best nation would be one which contrived the fullest expressions of its desires with the minimum of harm. Some repression would be necessary because some of our desires or feelings were developed under different conditions. Thus the desire to kill an enemy may formerly have been advantageous, but could not be allowed full play under existing social conditions. I think we all at times would be more pugnacious if we permitted ourselves absolute freedom! At the same time, there is no doubt that under present circumstances excessive repression works a great injury, as I stated in my former article. One may compare the desires of the people to water flowing through a valley; if it is permitted to flow where it will it may be useless for agriculture and may even do much damage; if it is merely dammed up it is equally useless and is likely to break loose and do more harm than in the first instance; but if, by skillful engineering, it is directed into suitable channels it may all be made available for mills and irrigation, while dangers of flooding are avoided. Let those who are engineering the United States remember this and aim neither to waste nor repress the desires and energies of the people, but use them all for the good of all.

SCIENTIFIC LITERATURE.

Elementary Solid Geometry and Mensuration. HENRY DALLAS THOMPSON, D.Sc., Ph.D., Professor of Mathematics in Princeton University. New York, The Macmillan Company. 1897. 8vo. Pp. vii+199.

Professor Thompson's text-book on Elementary Solid Geometry will be received with pleasure by American teachers of elementary mathematics. It fills an almost unoccupied place by confining itself to a narrow field. Colleges that do not require solid geometry for entrance will find it especially useful.

There are six chapters devoted to those parts of the elementary solid geometry ordinarily taught in our colleges and secondary schools, one appropriate chapter on the conic sections and one on mensuration. Each chapter, excepting the fifth, includes a large and well selected set of exercises.

Of course plane geometry is assumed but the first seven pages are given up to a careful, though designedly not exhaustive, consideration of certain fundamental notions. It is well stated that postulates are propositions 'taken without proof and upon which a train of reasoning is to be built,' and 'that it is no part of geometry to justify their use except in so far as their form is concerned.'

The sequence of propositions is developed in a scholarly and logical though decidedly conservative manner. The assumed construction is rigorously excluded. Many of the demonstrations are informal or left entirely to the student. The treatment of mensuration, apart from the geometry proper, is a good feature.

Considering the completeness of the work as a whole, the proof on pages 122 and 123 is noticeable. The theorem is: "The arc of a great circle less than a semicircle is the shortest line on the surface of a sphere between two given points not diametrically opposite." This proposition can only be proved by the use of some such postulate as the following: "The magnitude of a curved line is the limit toward which a broken line made up of consecutive chords of that curved line approaches when the number of chords is increased in such a manner that the chords are all diminished without limit." (Thomas S. Fiske, SCIENCE, Vol. IV., p. 724.) The words 'curved line' and 'broken line' are to be understood to mean respectively 'a line no part of which is a great circle arc' and 'a line made up of great circle arcs.' It seems unfortunate that such a postulate was not explicitly stated.

The terminology used is, on the whole, that of the average text-book, but the author has rendered a genuine service to the American geometric vocabulary by the introduction of Mr. Hayward's term 'cuboid' in place of the clumsy expression 'rectangular parallelepiped.'

The pages have a different appearance from those of the majority of our text-books, for they are solidly printed in the English style and no abbreviations are used.

C. B. WILLIAMS.

Thirty Years of Teaching. L. C. MIALL. London and New York, The Macmillan Company. 1897. Pp. viii+250. $1.00.

There is at present in the educational systems of all countries a circle—to call it a vicious circle would be over-emphatic—discriminating in favor of the classical languages and against the sciences. Those having a classical education at college and university find positions in the schools and in turn prepare boys for the classical course at college. The circle tends to remain unbroken. Teachers of the classics, being a great majority of all teachers, are apt to write most of the educational books. But from the point of view of the man of science a new era has begun when students of biology, such as Huxley, Morgan and Miall, begin to write on educational topics. The circle is broken and adjustment will follow in accordance with the physical principle of gravitation or the biological principle of the survival of the fittest.

Professor Miall's papers, reprinted with some additions from the *Journal of Education* (London), cover a wide range of subjects. He does not hesitate to write on the teaching of history, of geometry and of Latin grammar, as well as on nature study and school musuems, but throughout he urges by precept and by example the methods of natural science, of nature. Treat the child as a child, speak plainly, be interesting—such maxims are sufficiently trite, but they carry weight and influence when put in a book that treats the teacher as a teacher, and addresses him in a plain and interesting manner. Professor Miall's book will repay reading by the teacher, whether of the classics or of science, whether in the kindergarten or in the university.